

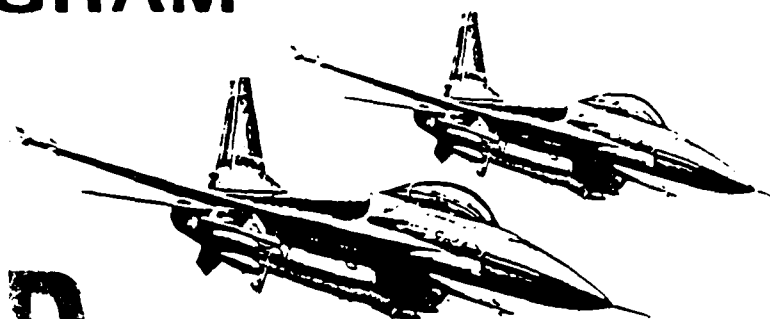
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INDUSTRIAL TECHNOLOGY MODERNIZATION PROGRAM



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APPENDIX I

USER SOFTWARE DOCUMENTATION

APPENDIX II

PROGRAM DOCUMENTATION

CATEGORY 2 PROJECT

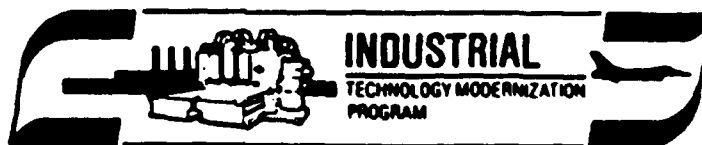
COMPUTER AIDED PROCESSING

SYSTEM (CAPS)

MARCH 20, 1987

DISTRIBUTION STATEMENT A

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APPENDIX I

USER SOFTWARE DOCUMENTATION

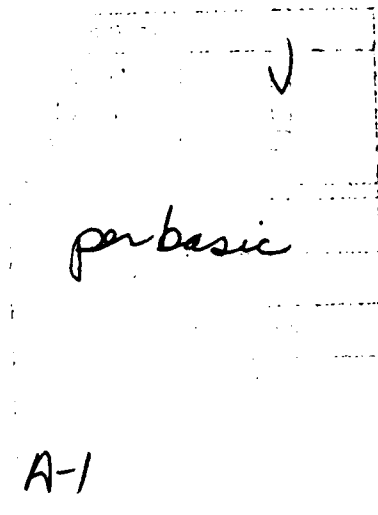


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1.0

USER SOFTWARE DOCUMENTATION

The purpose of this document is to provide the user with the knowledge and information necessary to use the CAPS instruction sheet generation module effectively.

1.1

System Overview

→ The Instruction Sheet generation module of the Computer Aided Processing System (CAPS) is a tool to aid the Manufacturing Engineer in writing/modifying Instruction Sheets in the Printed Wiring Board Assembly (PWA) area. It was designed to be as flexible as possible while minimizing the amount of input necessary to generate Instruction Sheets. To this end, CAPS uses existing information wherever possible; both CAD design data and TMCS Bills of Materials are electronically downloaded for use within CAPS.

At the heart of the CAPS Instruction Sheet generation module is the Method Code File, a file of discrete work elements specific to a work center, machine, or process. Due to the repetitive nature of PWB assembly, nearly all tasks necessary to manufacture a PWB have been uniquely identified, specified, time-studied, and listed in the Method Code File. These tasks remain uniquely identifiable via a three digit alphabetic identifier, the 'Method Code'.

By using this Method Code File in conjunction with the Bill of Materials for a given PWB, it becomes a fairly straightforward function to specify an instruction sheet; the Manufacturing Engineer simply specifies which method codes to apply to which BOM item numbers and groups like tasks into separate operations. From this, CAPS will generate consistent instruction sheets with consistent time standards.

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In addition to consistency, CAPS provides several additional benefits. For example, one may identify the possible ramifications of a process change by identifying which method codes are affected, and which assemblies use those method codes. Additionally, CAPS greatly reduces the risk of human clerical error by electronically producing Manufacturing Package cover sheets, and by electronically transferring routing information to TMCS.

The above benefits, when combined with the labor savings realized in creating an instruction sheet make CAPS a powerful tool for the Manufacturing Engineer.

CAPS was specifically designed to run on the VAX-11 family of minicomputers, running the VAX VMS operation system and using DEC VT-240 terminals.

1.2 Explanation of Terms

Input Sheet - This is the form into which the user makes his inputs. CAPS will use it to create the Instruction Sheet.

Instruction Sheet - The final output of CAPS, a detailed listing of all tasks which must be performed to manufacture the PWB assembly.

Prepare an Instruction Sheet - The process CAPS goes through to convert an Input Sheet to an Instruction Sheet.

Cover Sheet - A routing summary of the Instruction Sheet, with a historical record of changes and associated approvals.

Method Code - A three letter alphabetic code identifying a very specific function to be performed.

Method Code File - The file of individual method codes.

BOM - The bill of materials. These files are electronically downloaded from TMCS.

BOM to CAD Cross Reference File - This file is used as an interface between CAD design data and Bill of Material data. The CAD data is organized by individual reference designator while the BOM is organized primarily by item (or sequence) number. This file is created during the translation of CAD data, and its existence signifies the availability of CAD data for an assembly.

Background - A method of processing similar to batch processing, in which the process requires no further keyboard input and produces no screen output. The process runs independently, and the users terminal is free for other activities.

Foreground - The converse of background. A foreground process runs interactively with the users terminal. The terminal may not be used for other activities until the process completes.

1.3 How to Log On

Locate a DEC VT-240 terminal and turn it on. The on-off switch is a large tan rocker switch located on the left front side of the base unit. Turn it to the '1' position ('0' is off). The terminal will then run an internal diagnostic program which will last several seconds. The terminal should then beep and display the message "VT-240 OK" in the center of the screen. Now press the [RETURN] key several times until the following prompt appears:

Username:

At this point, enter the user name given to you by the system manager. The following message should then appear:

Password:

Now enter your password, also supplied by the system manager. To preserve security, the password will not be displayed on the screen. If you have successfully logged in, you will now be greeted by the system. Otherwise, the following message will appear:

User authorization failure

In this case you should try the above procedure again or contact the system manager.

2.0

MAIN MENU

To access the CAPS system, the user simply enters the command 'CAPS'. A menu similar to the following will appear:

CAPS

- Process instruction sheets
- Process cover sheets
- Process CAPS data files
- File information and maintenance
- Exit CAPS, return to operating system

The user may then choose the appropriate option by using the arrow keys on the terminal. The presently selected option will appear as dark characters on a light background. To access a specific option, move the selection bar to that option and press [RETURN] or [ENTER].

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2.1 Process Instruction Sheets

This option will allow the user to perform instruction related functions, including those relating to input sheets. See 3.0 for a detailed description of this option.

2.2 Process Cover Sheets

This option will allow the user to create, edit, or print a cover sheet. See 4.0 for a detailed description of this option.

2.3 Process CAPS Data Files

This option will allow the user to perform several different functions relating to CAPS data files, such as requesting that BOMs be downloaded or modifying the method code file. See 5.0 for a detailed description of this option.

2.4 File Information and Maintenance

This option will allow the user to inquire as to the status of certain CAPS data files, such as identifying which assemblies have been entered into CAPS. See 6.0 for a detailed description of this option.

2.5 Exit CAPS, Return to Operating System

This user may use this option to exit CAPS and return to the VAX VMS operating system.

3.0 PROCESS INSTRUCTION SHEETS MENU

When this option is selected, a menu similar to the following will appear:

CAPS

Input instruction sheet manually
 Prepare an instruction sheet for printing
 View a prepared instruction sheet
 Print a prepared instruction sheet
 Print an input sheet
 Return to previous menu
 Exit CAPS, return to operating system

The process of selecting an option is identical to that of the main menu.

3.1 Input Instruction Sheet Manually

This option allows the user to actually create/edit an instruction sheet. The user accomplishes this using an abbreviated form called an input sheet. The input sheet, like the instruction sheets, is organized into operations, with discrete tasks grouped within operations. The input sheet routine of CAPS is designed to allow the user as much flexibility as possible while keeping the amount of manual input to an absolute minimum. To use this routine, a BOM must be available within the system.

When this option is selected, the user will be prompted for the part number and revision. To abort this option, the user may press [RETURN] at the part number prompt. Once the part number and revision are entered, CAPS will begin to load the appropriate data files. After a short delay, the first page of the input sheet will appear. A sample input sheet appears below:

OPERATION NR. 010 DESCRIPTION: VERIFY.

WORKCENTER: 411121

MET	ITEM	VAR1	VAR2	STOCK.NR	REF	TL	TEXT	TIME
-----	------	------	------	----------	-----	----	------	------

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AAA	SETUP - VERIFY ITEMS FROM 1.110
-----	---------------------------------

OPERATION NR.	020	DESCRIPTION: STAGE.	WORKCENTER: 411121
---------------	-----	---------------------	--------------------

MET	ITEM	VAR1	VAR2	STOCK.NR	REF	TL	TEXT	TIME
<hr/>								
AAB	SETUP - STAGE ITEMS FOR							1.110

OPERATION NR.	050	DESCRIPTION: MARK.	WORKCENTER: 411121
---------------	-----	--------------------	--------------------

MET	ITEM	VAR1	VAR2	STOCK.NR	REF	TL	TEXT	TIME
<hr/>								
ABC	SETUP FOR MANUAL BOARD MA							18.00

ABE 1	5029981	MARK BOARD WITH SERIAL NU	1.428
-------	---------	---------------------------	-------

ABI	D	REVISION LETTER
-----	---	-----------------

This particular input sheet screen contains three operations: 10, 20, and 50. Should the user be entering an input sheet for the first time, it will have no existing operations. The screen will instead have a space to add the first record. The following discussion will describe the use of the input sheet routine.

In the course of editing an input sheet, the user will eventually have a need to do each of the following things:

- Add new operations
- Edit operation headers
- Add method codes within an operation
- Delete lines

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- Add free text
- Move around within an input sheet
- Examine method code entry
- Examine BOM entry

To simplify, this discussion will first describe the entries necessary for a user to create a completely new operation within an input sheet.

The start of an operation is signified by the presence of an operation header block. The user may insert a new operation header block by pressing the [CTRL] and [E] keys simultaneously. An operation header block looks like this:

OPERATION NR. ### DESCRIPTION: ##### WORKCENTER: #####

MET	ITEM	VAR1	VAR2	STOCK.NR	REF	TL	TEXT	TIME
-----	------	------	------	----------	-----	----	------	------

The # characters denote data fields which must be filled. The user may move both between and within the fields using the arrow keys, and should enter the appropriate information. The user may complete one entry and move to the next field by pressing the [ENTER] or [RETURN] key. Next the user will notice the last two lines of the operation header block. These lines serve to identify the columns or fields within the method code entry records. Any subsequent line is by default a method code entry record (unless otherwise defined as free text, as described later) until the start of the next operation header block. A method code entry record contains the following fields:

MET - The method code appears here. The method code will describe what is to be performed to the component in question.

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- ITEM - The item or sequence number of the component in question, from the BOM.
- VAR1 - Variable field 1. Use of this field varies, depending on the method code selected. For example, in a component prep operation, this field may contain the lead spacing.
- VAR2 - Variable field 2.
- STOCK NR - The Tracor stock number of the component in question. Taken from the BOM.
- REF - The reference designator of the component in question. Taken from the BOM.
- TL - Tool number. This number may be used to specify a tool via the footnotes at the bottom of the specific instruction sheet form.
- TEXT - The text describing what is to be done to the component in question. Taken from the method code file.
- TIME - The standard time for this type of task. Taken from the method code file.

After filling in the operation header block, the user should then move the cursor to the first method code entry record and enter the method code for the task which needs to be performed. Once the user makes this entry, the textual description of that method code will appear in the text field. The user should then indicate the component for this task by entering the appropriate item number from the BOM. Once this entry is complete, the Tracor stock number of the part will appear in the stock.nr field, and the first reference designator

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will appear in the ref field. The user should then enter any necessary variable fields (as described later). After the variable fields are entered, the method code entry will be expanded to include all reference designators in that item number. For example, item 5 on the BOM is a 123456-0001 resistor, quantity 4, reference designators R1 R2 R3 and R4. The user enters the method code specifying the task 'trim leads', and the item number 5. CAPS then creates one line for R1. Once the user enters the variable fields (in this case lead length), CAPS will create three more identical lines, specifying R2, R3, and R4. CAPS assumes that all four resistors will be treated the same since they are the same type of part. The user may, of course, override this by editing the new lines and changing the variable fields.

It should be noted that this input sheet is a very abbreviated form of the final instruction sheet. For example, the text description of the method code will be truncated on the screen, but will appear in its entirety on the final form.

The user may insert additional method code entry records within the input sheet by pressing the [CTRL] and [N] keys simultaneously.

Should the need arise, the user may enter lines of free text anywhere within the body of an input sheet (by pressing the [CTRL] and [W] keys simultaneously). These lines will have no formatting requirements, and the user is free to use them as he pleases. Free text lines will be incorporated verbatim into the final instruction sheet.

A summary of all the screen functions may be displayed by pressing the [HELP] key. A screen similar to the following will appear:

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Arrow Keys or	Tab.....TAB or ^I
Left.....^H	
Right.....^L	Page forward.....^B
Up.....^K	Page back.....^R
Down.....^J	EXIT = "DO" Jump to beginning/end...^P

EDIT FUNCTIONS

New operation heading.....^E	
Blank FORMATTED line.....^N	
Delete line.....^D	Find.....^F
Blank FREE TEXT line.....^W	Block ops.....^U

at FIND prompt:

^F	Repeat last find	sss....Input find string
----	------------------	--------------------------

BLOCK OPERATIONS

B.....set beginning of block	C.....copy block to cursor
E.....set end of block	D.....delete block
R.....reset block markers	M.....move block to cursor

As is evident from this screen, the input sheet routine supports many useful word processing features. The user who is familiar with any popular word processing software should have no difficulty in using these functions. Three keys were not included in the help screen are [NEXT SCR], [PREV SCR], and [FIND]. These perform the identical functions as ^B, ^R, and ^F. Note: the ^ character means 'control'. This means press the [CTRL] key simultaneously with the indicated key.

In addition to all the above, there are three more features to be discussed. These are 1) show method code entry, 2) show BOM entry, and 3) update input sheet. These functions are quite powerful, and will be discussed individually.

The user may, while entering an input sheet, obtain detailed method code information by pressing the [F14]

key. If the cursor is presently on a method code entry record line, then information for that method code will be displayed. The top of the screen will appear similar to this:

Method code display

```
Code  : AAA
Instr : SETUP - VERIFY ITEMS FROM STOCK
Instr :
Instr :
Ref   :
Time  :
R/S   : S
Var.cd: C
```

The user now has several options. He may type another method code, which will cause a similar display for that method code, or he may view the previous or next method code by pressing the [PREV SCR] or [NEXT SCR] key. Once finished viewing method codes, the user should press [RETURN], which will restore his original input sheet screen.

The user may perform a similar function for the BOM information by pressing the [F13] key. The BOM information for the present item number will be displayed at the top of the screen, similar to this:

BOM display

```
Item.nr: 1
Qty     : 3
TSN     : 123456-0001
ID nr   : 223422
Desc    : RESISTOR, 1/4 WATT CARBON FILM
Ref des: R1,2,3
```

The user may then view another item number (by entering a new item number, or pressing the [NEXT SCR] or [PREV SCR] key), or return to the input sheet screen by pressing the [RETURN] key.

The user may also 'update' an input sheet by pressing the [F10] key. This function will perform three things. First, it will read each and every method code from the input sheet and look it up in the present method code file, updating the method code text and standard time. This will be useful if the method code file has changed recently, as the input sheet will now reflect present standards and methods. Second, it will read each and every item number from the input sheet and look it up in the BOM. The Tracor stock number will be updated. This will be useful if, for example, one resistor on a board is upgraded from a 10% to a 5% tolerance. This results in a new Tracor stock number for the part, but the method applied to it will not change. Therefore, when an input sheet is revised for a specific reason, all entries are updated even though they may not be related to that reason. Lastly, CAPS will search for reference designator discrepancies between the BOM and the input sheet. Any reference designators appearing in one but not the other will be announced, and the user will be prompted to press [RETURN]. This should help identify any added or deleted parts.

To exit the input sheet routine, the user should press the [DO] key. The following will appear at the top of the screen:

- 1 - Save file and exit
- 2 - Save file and return to Program
- 3 - return to program
- 4 - optimize prep operations
- 0 - abandon file and exit

Your choice:

The user should now press the [0], [1], [2], [3], or [4] key to choose the appropriate option. 'Save file' means save any changes which were made to the input sheet. 'Abandon file' means ignore any changes made, do not save them. 'Exit' means return to the Instruction sheet menu (see 3.0). 'Return to program' means go back into the input sheet program, editing the same input sheet. To edit another input sheet, it is necessary to return to the Instruction sheet menu.

Option 4, 'optimize prep operations' will group prep operations by machine, and will arrange them such that the machine settings sequence from smallest to largest. This is to minimize the setup time for the machine operator. Note: If option 4 is chosen, all free text will be shifted to the end of the text for that operation.

3.2 Prepare an Instruction Sheet for Printing

This option will prepare an image of the instruction sheet in its final form. The image may be printed or viewed on the screen for a period of seven days, after which it will be purged from the system. Should it be necessary to view or print the instruction sheet after this time, it must be created again using this option. Should an instruction sheet for the same assembly nr./rev nr. already exist, it will be replaced.

When this option is selected, the user will be prompted for the part number, revision, and a description. The description will appear on each page of the instruction sheet as well as the cover sheet. To abort this option, the user may press [RETURN] at the part number prompt. The Process instruction sheets menu will appear several seconds after the description is entered. The request will be processed in 'background' and the user may continue with other activities. A message will be broadcast to the user once the instruction sheet is completed.

3.3 View a Prepared Instruction Sheet

This option will allow the user to view any instruction sheet which has been 'prepared' (see 3.2). The user will be prompted for the part number and revision. To abort this option, the user may press [RETURN] at the part number prompt. After the revision is entered, the system will allow the user to view the instruction sheet using the VAX/VMS EDT text editor in 132 column read only mode. The characters on the screen will be compressed so as to fit the entire width of the instruction sheet on the screen. The user may then perform any functions allowed by EDT (such as paging, searching, etc.), but any changes made will not be saved. For a detailed description of EDT, consult the VAX/VMS EDT users guide. Once the user exits EDT, the Process instruction sheets menu will appear.

3.4 Print a Prepared Instruction Sheet

This option will allow the user to print part or all of any instruction sheet which has been 'prepared' (see 3.2). The user will be prompted for the part number and revision. To abort this option, the user may press [RETURN] at the part number prompt. After the revision is entered, the system will prompt the user for the number of copies to be printed. Next, the system will prompt for the starting and ending page numbers to be printed. The user may print the entire instruction sheet by pressing [RETURN] twice. Alternatively, the user may print a single page or a range of pages by specifying the appropriate starting page and ending page numbers. The page numbers should correspond to the actual number printed on the page rather than the physical page count. For example, instruction sheet 123456-0001 begins with page number 3. To specify pages 4 thru 6 the user would enter 4 and 6, even though he actually wants the 2nd, 3rd, and 4th pages of the document.

The user will then be prompted as to which printer to use. After specifying which printer, the job will be printed and the Process instruction sheets menu will appear.

3.5 Print an Input Sheet

This option works much the same as printing the instruction sheets (see 3.4), the difference being it is the input sheet itself which is printed. Therefore the printed copy will not be a document for official release, but rather a hard copy of the form used when specifying an instruction sheet manually (see 3.1). After all parameters are entered, the Process instruction sheets menu will appear.

3.6 Return to Previous Menu

This option will return the user to the main menu. The main menu is described in 2.0.

3.7 Exit CAPS, Return to Operating System

This user may use this option to exit CAPS and return to the VAX VMS operating system.

4.0 PROCESS COVER SHEET MENU

This option provides the interface between CAPS and the Tracor Aerospace Manufacturing Package Information System. This system will allow the user to Create, Edit, and Print Manufacturing Package cover sheets and instruction sheets. The system is documented in a separate document, which is included within this document as Section 11.0. The system may be used as documented, but the following notes should help the user make better use of the Manufacturing Package System when used in conjunction with CAPS.

The Manufacturing Package system has provisions for operations and instruction sheets. These provisions should be ignored by the CAPS user, since CAPS was specifically designed to handle this function.

When the user 'Prepares' an instruction sheet, CAPS will replace any operations currently existing within the cover sheet with those on the instruction sheet. The instruction sheet and the cover sheet will therefore always match.

The CAPS user should create or update the cover sheet prior to 'preparing' the instruction sheet. This will prevent many problems, such as CAPS attempting to insert operations into a nonexistent cover sheet.

5.0 PROCESS CAPS DATA FILES MENU

When this option is selected, a menu similar to the following will appear:

CAPS

- Options for the CAPS Database
- Process method code file
- Process Component parameter file
- Download BOM data from Univac
- Analyze method code
- Return to previous menu
- Exit CAPS, return to operating system

The process of selecting an option is identical to that of the main menu.

5.1 Process Method Code File

This option will allow the user to display, edit, or print the present method code file. See 7.0 for a detailed description of this option.

5.2 Process Component Parameter File

This option will allow the user to display, edit, or print the present component parameter file. See 8.0 for a detailed description of this option.

5.3 Download BOM Data From Univac

This option will allow the user to request that one or more BOMs be downloaded from TMCS to the VAX for use by CAPS. After this option is selected, a screen similar to the following will appear:

Using EDT, enter the assembly numbers of the BOMs you wish to download.

Note: please enter only one assembly per line, in the format:

Assembly# Revision

One moment please...

=====

1 123456-0001 A1

*

The user is now in the VAX/VMS EDT text editor. The file currently being edited will contain a list of the BOMs last requested to be downloaded. The user should edit this file to reflect the BOMs he wished to be downloaded. Typically, the user would delete all existing numbers and add the new ones. The format for this file is as stated in the downloaded screen: one

BOM entry per line with no blank lines. A BOM entry consists of the assembly number, one space, and the revision level of the manufacturing package for which this BOM will be used. The following is an example of a correctly formatted BOM request file:

```
123456-0001 A-  
12345-SA01(S) --  
5029990 C1
```

Note: the revision level always applies to the manufacturing package, never to the BOM itself. The user may not specify the actual BOM revision; CAPS always downloads the latest revision of the BOM available. The revision which the user specifies is used to indicate which manufacturing package this BOM will be used on.

For more information in the use of the EDT text editor, the user should consult the VAX/VMS EDT Users Guide.

Shortly after the user exits EDT, a screen similar to the following will appear:

Choose option:

1) Download files 2) Re-enter files 0) Abort download

=====

```
123456-0001 A-  
12345-SA01(S) --  
5029990 C1
```

The assembly numbers listed should match what the user desired to download. The user may continue with the download procedure by pressing the [1] key, return to EDT by pressing the [2] key, or abort the entire download procedure and return to the menu by pressing the [0] key. Should the user choose to continue with the download procedure, the CAPS main menu will appear. The download request will be processed in

'background', and the user may continue with other activities. Once the download procedure has completed, the user will be notified via a message on the terminal and an electronic mail message. The message on the screen will appear:

The BOM download has completed.

or

The BOM download has completed with errors.

The mail message will be more specific, and will list the assemblies in question. Should the message indicate an error occurred, please forward the mail message to KING using the FORWARD command of the VAX/VMS MAIL utility. For more information on MAIL, consult the VAX/VMS MAIL documentation.

5.4 Analyze Method Code

This option will allow the user to search all instruction sheets for a specified method code. It is intended to aid the user in answering methods analysis type questions, such as "how many assemblies use this method?". When this option is selected, the user will be prompted for the method code to search for. The user should enter a three digit alphabetic method code, in capital letters. Next, the user will be asked to specify an output file. He should specify a standard VAX/VMS filename (for more information on VAX/VMS filename syntax, consult the VAX/VMS Files guide). After the user has specified his output file, a screen similar to the following will appear:

CAPS

Method Code to analyze : ABC

Filename for output : fred.txt

Search all revs of each input sheet
Search just latest rev of each input sheet
Abort the analysis, return to previous menu

The bottom three lines list the options the user may now choose, and will act in a manner similar to all previous menus. The first option will search each and every input sheet currently on file, while the second will limit its search to just the latest revision of each input sheet. The third option will perform no search at all, and return the user to the Process CAPS data files menu (see 5.0).

The method code analysis will run in 'background', and the user may continue with other activities. All output will be written to the file specified by the user. Once the method code analysis is complete, the user will be notified by a message on the terminal screen. He may then examine his output file for the results (by typing it, printing it, editing it, etc.). The output file should look similar to the following:

Method Code Analysis for QAB in latest revision only.

```
1 occurrences in 10_122484_2 A_  
3 occurrences in 144636_0001 D_  
4 occurrences in 156211_0002 __  
1 occurrences in 156224_0001 A_  
11 occurrences in 156230_0001 B_  
22 occurrences in 5030075 E_  
17 occurrences in 5030080(F) __  
1 occurrences in 562977_0002 F_
```

QAB occurs a total of 60 times in 8 of 358 assemblies searched.

The output file is not a CAPS data file, but rather a simple text file owned by the user. The user is therefore free to dispose of this file as he pleases.

5.5 Return to Previous Menu

This option will return the user to the main menu. The main menu is described in 2.0.

5.6 Exit CAPS, Return to Operating System

This user may use this option to exit CAPS and return to the VAX VMS operating system.

6.0 **FILE INFORMATION AND MAINTENANCE MENU**

When this option is selected, a menu similar to the following will appear:

CAPS

Copy old input sheet data
Update BOM revision letter
Status of current CAPS files
Return to previous menu
Exit and return to operating system

The process of selecting an option is identical to that of the main menu.

6.1 Copy old input sheet data

This option gives the user the ability to copy input sheet data into a new input sheet with a different part or revision number. It may be used in two cases: 1) to create a new revision of an instruction sheet, or 2) to create a completely new instruction sheet for a different part number (where parts are similar). When this option is selected, the user will be prompted for the following information: old part number, old revision number, new part number, new revision number. The user

may create a new revision of an existing instruction sheet by either entering the same part number as both old and new, or by just leaving the new part number blank. After entering all requested information, CAPS will attempt to verify the users request by displaying a message such as:

Change rev of 123456-0001 from A- to B-

or

Create input sheet 123456-0001 rev -- from 232323-9999 rev zz

The message will be followed by a prompt similar to the following:

Process this request? Y/N

The user may press [Y] to process the request, or [N] to abort the request. In either case, CAPS will return to the File information and maintenance menu (see 6.0).

The user should realize that after using this option, an input sheet will exist for which there will be no matching BOM.

6.2 Update BOM revision letter

This option will allow the user to link an existing BOM to a newer revision instruction sheet. For example, a new revision of an instruction sheet is created to effect a process change; there have been no changes to the BOM. For CAPS to function correctly, the new instruction sheet must have a BOM associated with it. The user has two choices: he may download a new BOM, or he may change the revision level of the previous BOM. The user should be aware that once he uses this option, the specified BOM is no longer associated with the previous revision instruction sheet.

Once this option is selected, the user will be prompted for the part number, the present revision number, and the new revision number. The files will then be updated, and CAPS will return to the File information and maintenance menu (see 6.0).

6.3 Status of current CAPS files

This option will allow the user to inquire as to the status of various CAPS data files. See 9.0 for a detailed description of this option.

6.4 Return to Previous Menu

This option will return the user to the main menu. The main menu is described in 2.0.

6.5 Exit and Return to Operating System

This user may use this option to exit CAPS and return to the VAX VMS operating system.

7.0 PROCESS METHOD CODE FILE

This option will allow the user to display, edit, or print the present method code file. When this option is selected, a menu similar to the following will appear:

CAPS

PROCESSING OPTIONS - FOR FILE methodcod.dat

Modify record
Display record
Print all records
Delete record

Return to previous menu

Exit and return to operating system

The process of selecting an option is identical to that of the main menu.

7.1 Modify Record (Process Method Code Menu)

This option will allow the user to modify any record in the method code file. When this option is selected, a screen similar to the following will appear.

Modifying file methodcd.dat

Code :
Instruction :
Instruction :
Instruction :
Reference :
Time :
Run or Setup time? (R/S) :
Variables- Text, Calc, or Formulas (T/C/F) :

The cursor will appear in the code field, and the user should now enter the method code desired. The user may return to the menu described in 7.0 by pressing [RETURN] instead of entering a method code.

After entering a method code, the other data items will appear in their appropriate fields. The user may change them as necessary, and the arrow keys will allow the user to move between them. To end the editing session, the user should move to the bottom field and press [RETURN], [ENTER], or the down arrow key. The following prompt will then appear:

Is this correct? Y/N

To save any changes made, the user should press the [Y] key. To ignore any changes made, the user should press the [N] key.

Once the [Y] or [N] key is pressed, the data fields will clear and the user should now enter the next method code, and repeat the entire process. The user may return to the menu described in 7.0 by pressing [RETURN] instead of entering a method code.

7.2 Display Record (Process Method Code Menu)

This option will allow the user to view on the screen all the information associated with a method code, but will not allow him to change it. This option is very similar to the modify record option (see 7.1), with the above difference. When this option is selected, a screen identical to that in (7.1) will appear, and the user should enter the method code desired. Once the method code is entered, the other information will appear in the appropriate fields. A message similar to the following will then appear:

Press RETURN to continue

When the user is done viewing this method code, he should press the [RETURN] key. The original screen will then reappear, and the user should enter the next method code. The user may return to the menu described in 7.0 by pressing [RETURN] instead of entering a method code.

7.3 Print All Records (Process Method Code Menu)

This option will allow the user to print a copy of the method code file. Once this option is selected, the user will be prompted as to which printer to use, followed by a short delay while the method code file is converted to a printable

form. The file will then be printed, and CAPS will return to the Process method code menu (see 7.0).

7.4 Delete Record (Process Method Code Menu)

This option will allow the user to remove an individual method code record from the method code file. When this option is selected, a screen identical to that in (7.1) will appear, and the user should enter the method code desired. Once the method code is entered, the other information will appear in the appropriate fields. A message similar to the following will then appear:

Delete this record? Y/N

If the user presses the [Y] key, then this record will be deleted. To avoid deleting this record, the user should press the [N] key. In either case, the original screen will then reappear, and the user should enter the next method code. The user may return to the menu described in 7.0 by pressing [RETURN] instead of entering a method code.

7.5 Return to Previous Menu (Process Method Code Menu)

This option will return the user to the main menu. The main menu is described in 2.0.

7.6 Exit and Return to Operating System (Process Method Menu)

This user may use this option to exit CAPS and return to the VAX VMS operating system.

8.0

PROCESS COMPONENT PARAMETER FILE

When this option is selected, a menu similar to the following will appear:

CAPS

PROCESSING OPTIONS - FOR FILE component.dat

Modify record

Display record

Print all records

Delete record

Return to previous menu

Exit and return to operating system

The process of selecting an option is identical to that of the main menu.

8.1

Modify Record (Process Component Parameter File Menu)

Similar to the 7.1, except that the fields displayed will be for parameters relating to the component type specified. The fields displayed will vary with the component type; for example, diodes will have different parameters than resistors. The description of each field will be of sufficient detail to identify its function, however.

8.2

Display Record (Process Component Parameter File Menu)

Similar to 7.2, with differences as described in

8.1.

8.3 Print All Records (Process Component Parameter File Menu)

Similar to 7.3, with differences as described in Section 8.1.

8.4 Delete Record (Process Component Parameter File Menu)

Similar to 7.4, with differences as described in 8.1.

8.5 Return to Previous Menu (Process Component Menu)

This option will return the user to the main menu. The main menu is described in 2.0.

8.6 Exit and Return to Operating System (Process Component Menu)

This user may use this option to exit CAPS and return to the VAX VMS operating system.

9.0 STATUS OF CURRENT CAPS FILES

This option will allow the user to inquire as to the status of various CAPS data files. When this option is selected, a menu similar to the following will appear:

CAPS

List input sheets on file
List BOM's on file

List BOM-CAD cross reference files
List prepared instruction sheets on file
Return to previous menu
Exit and return to operating system

The process of selecting an option is identical to that of the main menu.

9.1 List Input Sheets on File

This option will display on the terminal screen all input sheets currently on file within CAPS. Shortly after this option is selected, a screen similar to the following will appear:

Input sheets	<Next-Scr>:forward <Prev-Scr>:back <Do>:exit		
10-123774-1 B-	131870-0001 D1	131870-0001 D-	133820-0001 M-
136534-0001 E3	137429-0004 D-	138200-0001 G4	140479-0001 M-
141047-0001 K-	141622-0004 —	154867-0003 —	161059-0001 -2
5029945 B-	5030005 C-	5030040 B2	5030065 F1
5030080 D1	5030289 D-	5030313 G-	

The screen is divided into four columns, each with one assembly number followed by the revision level. Should there be more assemblies than will fit on one screen, the user may page the screen forward or backward. To page forward, press the [NEXT SCREEN] key. To page backward, press the [PREV SCREEN] key. To return to the Status of current CAPS Files menu (9.0), press the [DO] key.

9.2 List BOM's on File

This option is virtually identical to 9.1, except that the assembly numbers shown will reflect the BOMs on file.

9.3 List BOM-CAD Cross Reference Files

This option is virtually identical to 9.1, except that the assembly numbers shown will reflect the BOM-CAD cross reference files.

9.4 List Prepared Instruction Sheets on File

This option is virtually identical to 9.1, except that the assembly numbers shown will reflect the prepared instruction sheets on file. The user should be aware that prepared instruction sheets will be deleted after seven days. They may, of course, be re-prepared.

9.5 List Cover Sheets on File

This option is virtually identical to 9.1, except that the assembly numbers shown will reflect the cover sheets on file. These are not printable cover sheets, but rather the historical information appearing on the cover sheet which cannot be extracted from the instruction sheets. These may be created or edited (see 4.0).

9.6 List Prepared Cover Sheets on File

This option is virtually identical to 9.1, except that the assembly numbers shown will reflect the prepared cover sheets. These may be printed (see 4.0).

9.7 Return to Previous Menu

This option will return the user to the main menu. The main menu is described in 2.0.

9.8 Exit and Return to Operating System

 This user may use this option to exit CAPS and return to the VAX VMS operating system.

10.0 NOTES ON THE EFFECTIVE USE ON CAPS

 To use the CAPS Instruction Sheet generation module most effectively, the Systems Coordination staff offers the following hints:

Typical sequence for a new assembly

STEP 1, Manufacturing Engineer requests the appropriate BOM to be downloaded from TMCS into the VAX.

STEP 2, the Manufacturing Engineer creates an input sheet for the assembly. He creates individual operations as necessary, and within each operation he specifies the method code necessary and the item number (sequence number) on the BOM, and any appropriate variables.

STEP 3, the Manufacturing Engineer updates the cover sheet. He enters any information which may be required.

STEP 4, the Manufacturing Engineer prepares the input sheet. this option causes CAPS to create the actual instruction sheet which will be printed.

STEP 5, the Manufacturing Engineer may view the instruction sheet, print the instruction sheet, or print the cover sheet.

Should the input sheet routine not behave as expected, the user should verify that the BOM information is available and correct by using the [F13] function within the input sheet routine.

Should the user experience difficulties in preparing the instruction sheet, the user should check for differences between the input sheet and the BOM by using the [F10] function.

11.0 MANUFACTURING PACKAGE INFORMATION SYSTEM

Manufacturing Package Information System is the software system used by Tracor Manufacturing Engineers to input, change, delete, and view manufacturing package and cover sheet information. The program is run on the Manufacturing VAX computer, and the information is uploaded into the UNIVAC for use by the TMCS Engineering Records/Manufacturing Package System.

The system saves the current package revision as well as the two prior revisions. All other revisions are purged. The system will display the current revision. If you want to display another revision, contact Systems Coordination.

11.1 Starting the Program

To start the program, log on to the VAX computer. (See Appendix A at the back of this manual for log-on instructions if you are connected to the TRRR (Dataswitch Network.) If you are not connected to the TRR Network, press return and you will be prompted to enter your USERNAME and PASSWORD.

Many users have their password assigned in such a way that Manufacturing Package Information System is started automatically. If your password does not start the program automatically, simply type 'FAB' at the '\$' prompt.

SAMPLE LOG-ON:

Username: SMITH

Password: ABC

\$ FAB

11.2

Movement Keys

Next Field	To move forward to the NEXT FIELD, use RETURN or ENTER.
Previous Field	To move backward to the PREVIOUS FIELD, use the TAB key.
Next Screen	To move forward to the NEXT SCREEN, either use the DOWN ARROW key or the RETURN key to move the cursor past the bottom of the current screen. You may also use the tab key to move to the next screen, as long as the cursor is in the first field of the current screen (excluding the instruction sheet screens.)
Previous Screen	To move backward to the PREVIOUS SCREEN, use the PF4 key.
Insert/Overwrite	To toggle the insert/overwrite mode, use CTRL V.
Delete Left	To delete the character to the left of the cursor, use the DELETE key.
Delete Under	To delete the character under the cursor, use CTRL G.

11.3

PF Keys on the Different Terminals

NEC PC - The last four function keys (in the upper right corner of the keyboard) are the PF keys. (These keys are grey.)

IBM-Compatibles - PF1=F1, PF2=F2, PF3=F3, PF4=F4

Zenith Terminal - PF1=F6, PF2=F7, PF3=F8, PF4=F1

Tracor Aerospace

ADM22 - PF4-ESC key. (There are no other PF keys.)

ADM220 & VT Terminals - All PF keys are labeled.

Once you have logged on, the following menu will appear:

FFFFFF	AA	BBBBB
F	A A	B B
FFFF	A A	BBBBB
F	AAAAAA	B B
F	A A	B B
F	A A	BBBBB

Version 3.0

Modify

Print

Delete

Inquiry

Exit

11.4

To Add a Manufacturing Package Record

1. Position the cursor beside the MODIFY option and press return. (Move the cursor by using the arrow keys.)
2. You will be prompted for the part number of the new record. Enter the part number and press return or enter.
3. If the part is not currently in the system, the Purpose of Change screen will appear without any data on it. If the part is already in the system, the Purpose of Change screen will display whatever data has been entered. (See Section 11.4.1)

11.4.1

Purpose of Change Screen -

Part number : 133798-0001		Program : CM	
Description : MODULE, FLARE			
MP REV	Purpose of Change	ME/Date	QE/Date
Q-	CHANGED TO VAX FORMAT. CORRECT MP REV.	LRE 12/03/86	/ /
		/ /	/ /
		/ /	/ /
		/ /	/ /
		/ /	/ /
		/ /	/ /

The Purpose of Change Screen corresponds to the upper left portion of the manufacturing package cover sheet. Up to 10 revisions may be entered on this screen and each revision has two lines available for the Purpose of Change. NOTE: If all the MP REV fields are filled, press the PF1 key to scroll up a blank line (this erases the oldest revision data). Pressing PF1 to scroll up may be performed at any purpose of change line on the screen.

If you are adding the record for the first time, only the part number will be displayed. You should enter:

- o The Program Name
- o Description
- o MP Revision

- o Purpose of Change
- o ME initials on the first line. Date of authorization on the second line.

NOTE: Two lines are provided for the Purpose of Change in each revision block. If you require more room, leave the next MP REV blank and continue entering information in the Purpose of Change column. Use as many revision blocks as necessary. IMPORTANT: Although you should leave the MP REV field blank for additional Purpose of Change information, you must enter a period (.) in the blank MP REV fields when you enter the next revision. (Do not enter the period until you are ready to enter the next revision.)

In the ME/Date and the QE/Date columns, you will enter the initials of the person authorizing the revision on the first line and the date of authorization on the second line between the slashes. The initials must be left-justified within the column. The date is MM/DD/YY.

When the cover sheet is printed, the initials in the last revision block on the screen will not appear on the printed copy. (The date will print.) This gives the authorizing engineer room to initial the cover sheet.

When you are through with this screen, use the DOWN ARROW or the RETURN key to move the cursor past the bottom line of the screen. This will allow you to advance to the next screen.

11.4.2 Document Screens - The following two screens contain information found in the Manufacturing Package section of the cover sheet.

NOTE: If the last line of the second page of documents is blank, then it is possible to insert a blank line above the cursor position by pressing the PF1 key. This will scroll the remaining documents down one line. You may also delete a line at the cursor position by pressing PF2.

Part number :		133798-0001				
FSCM	PRE	Document	Page 1	COD	Rv	Routing
		133798		DWG	J	8,10,12
	PL	133798-0001		PL	K	8,10,12
	BOM	133798-0001		BOM	C	8,10,12

NOTE: For further information about document entry, please see "Document List Guidelines for VAX MP Data Base" available from Systems Coordination.

When adding document information on this screen, enter the following: (Use capital letters for consistency.)

- o FSCM number. The FSCM number is required for purposes of documentation control and is used to distinguish between Tracor or another contractor as a design/documentation activity. When the document is a Tracor document (FSCM 19397), the FSCM field can be left blank.

- o Prefix. Prefixes are used to distinguish between documents having the same basic document number; e.g.,

PL 141020-0002	Parts List
141020-0002	Assembly Drawing

If the document has a prefix, enter it in the PRE field. Prefixes must be left-justified within the field.

- o Document number. The document number must be entered exactly as shown in the title block. Care must be taken that Part Number Indicators (dash numbers) are not entered unless the dash numbers are included in the document title blocks.
- o Type. The type codes are used as a means of classifying the nature of the document for manufacturing purposes. Enter the document type in the COD field. The type must be left-justified within the field.

IMPORTANT

- (a) Enter documents in the following order:

1. DWG
2. PL
3. BOM
4. Other documents

- (b) Change documents (ECOs, etc.) must be listed directly under the affected document and indented one space; e.g.,

FSCM	Prefix	Document #	Cod
		136560	DWG
		T29265-01	ECO

- (c) Deviations and waivers do not need to be associated with any one document because they are part-related and not included in the Document Release Record. These should be left-justified within the Document Number field.
 - (d) Quick Fix do not have dash numbers in the document title block. Some PLs cover multiple part configurations, but the document is analogous to a Tracor drawing with multiple dash numbers in the field of the drawing.
- o RV. The document revision number.
 - o Routing. Enter the Toll Gates in this field. Toll gates must be separated by a comma.

When you are through with this screen, use the DOWN ARROW or the RETURN key to move the cursor past the bottom line of the screen. This will allow you to advance to the second page of the Document Screen. When you are through with the second page, move the cursor past the bottom line of the screen to go to the Special Notes Screen.

11.4.3 Special Notes Screen

Part Number :	133798-0001			
<table border="1"><tr><td>Update Existing MP : Y Allow Alternate Build : N</td></tr><tr><td>Special Notes</td></tr><tr><td>1. USE BOX FAN FOR PROPER VENTILATION 2. USE UV LIGHT TO VERIFY PROPER COATING</td></tr></table>		Update Existing MP : Y Allow Alternate Build : N	Special Notes	1. USE BOX FAN FOR PROPER VENTILATION 2. USE UV LIGHT TO VERIFY PROPER COATING
Update Existing MP : Y Allow Alternate Build : N				
Special Notes				
1. USE BOX FAN FOR PROPER VENTILATION 2. USE UV LIGHT TO VERIFY PROPER COATING				

Tracor Aerospace

On the Special Notes Screen, enter:

- o Y or N in the UPDATE EXISTING MP field. (Default = N)
- o Y or N in the ALL ALTERNATE BUILD field. (Default = N)
- o Any appropriate special notes.

When you are through with this screen, use the DOWN ARROW or the RETURN key to move the cursor past the bottom line of the screen. This will allow you to advance to the next screen.

11.4.4 Instruction Sheets Screen

P #	Seq	Setup	Run	NC	Instructions
0010	1	1.00	0.000	411410	^VERIFY.
OP #	Seq	Setup	Run	NC	Instructions
0020	1	0.10	0.087	411410	^ASSEMBLE.
OP #	Seq	Setup	Run	NC	Instructions
0025	1	0.00	0.000	761200	^INSPECT.
OP #	Seq	Setup	Run	NC	Instructions
0026	1	0.00	0.000	360000	^TOLLGATE 10.

NOTE: Press the PF1 key and the up arrow key to scroll the operation window up one operation.
Press the PF1 key and the down arrow key to scroll the operation window down one operation.

Press PF2 to display the previous four operations (from the cursor position).

Press PF3 to display the next four operations (from the cursor position).

On the Instruction Sheets Screen, enter:

- o The Operation Number. (Use four digits.)
- o The Sequence Number. This number will usually be '1', unless the instructions are exceptionally long. On each Operation/Sequence, there is room for three and a half lines of instruction. If you require more space, enter the same operation number in the next operation field and enter '2' in the Sequence field. If you require still more space, enter '3' in the next Sequence field, and so on until you are done. (After '9', begin with capital 'A' through 'Z'.)
- o The Setup Time. (The decimal point is a floating point.)
- o The Work Center Number.
- o Instructions.
 - (a) Note that a key word from the instructions appears as the description of the operation on the cover sheet. To mark the word to appear as the key, put a '' in front of the word. (Sample: 'Verify). The system will pick up eleven characters.
 - (b) In addition, the fabrication department has a list of shorthand codes which, when entered in the instruction field, will cause the

extended description to appear automatically on the screen and the printed instruction sheets. See Attachment A for a complete list of these shorthand codes.

- (c) Certain key words will cause the work center number to be printed automatically on the cover sheet. This makes it unnecessary to enter the work center number on this screen. For a complete list of these key words, see Attachment B.
- (d) To cause a portion of the instructions to be started on a new line when printed, use the ''' to mark the section. You must leave a space before and after the ''.

EXAMPLE:

On-Screen:

BREECH PLATES ARE TO BE HANDLED WITH CARE; WRAPPED IN BUBBLE OR OTHER TYPE OF PROTECTIVE WRAP. ` Silk-screen and identify per Notes #2 and #14 of dwg. and SP 141.

Becomes when printed:

BREECH PLATES ARE TO BE HANDLED WITH CARE; WRAPPED IN BUBBLE, OR SOME OTHER TYPE OF PROTECTIVE WRAP. Silkscreen and identify per Notes #2 and #14 of dwg. and SP 141.)

- (e) To cause a portion of the instructions to be started on a new page when printed, use the '\$' to mark the section. (This is also used to leave a blank page after the last operation.)

NOTE: Type '\$\$' to move to the top of the next page and then skip an entire page when printing. This allows you to leave a blank page between operations.

NOTE: There is room for four Operations/Sequences on each screen. If you need to enter more than four, use the RETURN key or DOWN ARROW to move the cursor past the bottom of the screen or press the PF3 key to display four more Operations.

11.4.5 Saving the New Package - Once you have entered the instructions, use the PF4 key (or DO key or ESC key) to scroll backwards through the screens. When you reach the Purpose of Change Screen, press once more, and the system will prompt you:

Save this record? Y/N

Enter 'Y' to save the record. The program will then prompt you with:

Part Number:

This gives you an opportunity to enter another record. If you have no more records to enter, press the PF4 key again to return to the Manufacturing Package Information System menu.

11.5 To Change an Existing Manufacturing Package

1. Select Modify on the Main Menu.
2. Enter the part number you want to change when prompted to do so.
3. Use the keys described in Section 11.1 to move to the fields you wish to change.

4. Use the PF4 key to return to previous screens.
5. To exit, use the PF4 key to return to the first screen, and enter 'Y' when prompted with the message 'Save this record? (Y/N)'. If you do not enter 'Y', your changes will not be saved. Press the PF4 key again to return to the Main Menu.

NOTE: See Sections 11.4.1 - 11.4.4 for further information about what data should be entered in each field.

11.6

To Display a Manufacturing Package

1. Select Modify on the Main Menu.
2. Enter the part number when prompted to do so.
3. Use the DOWN ARROW or the RETURN key to move down through the screens.
4. Use the PF4 key to return to previous screens.
5. To exit, use the PF4 key to return to the first screen, and enter 'N' when prompted with the message 'Save this record? (Y/N)'.
6. The words 'Part number' will be displayed again to give you an opportunity to enter another record. If you have no more records to enter, press the PF4 key again to return to the Main Menu.

11.7

To Print a Manufacturing Package

1. Select Print on the Main Menu.

2. Enter the part number when prompt to do so.
3. The system will display the Purpose of Change Screen and prompt you with the message:
'Do you want to print this cover sheet? Y/N'
4. If you want to print the cover sheet, type 'Y'. You will then be given a choice of printers. Choose one.

Choose Printer

- 1) Bldg 2 Printronix
- 2) Bldg 8 Printronix
- 3) Laser 1
- 4) Laser 2

The screen will go blank for a few moments while the system generates the cover sheets and sends it to your choice of printers. Once this is done, the system will prompt you with the message:

'Print instruction sheets? Y/N'

5. If you want to print the instruction sheets, type 'Y'. The system will then prompt you with the message:

Choose Printer

- 1) Bldg 2 Printronix
- 2) Bldg 8 Printronix
- 3) Local Printer

6. (a) If you answer '1' or '2', the system will print the instruction sheets on one of the Printronix printers.

- (b) If you answer '3', the system will attempt to print the instruction sheets on a printer hooked up to your terminal. It will prompt you with the message:

'Insert instruction sheets and hit <RETURN>.'

Once you press the RETURN key, the system will attempt to print the instruction sheets on your printer.

It will continue prompting you with the 'Insert instruction sheet and hit <RETURN>' message until all the instruction sheets have been printed.

7. Once the printing is finished, the words 'Part number' will be displayed again to give you an opportunity to print another record. If you have no more records to print, press the PF4 key again to return to the Main Menu.

11.8

To Delete a Manufacturing Package

The delete option will delete the entire manufacturing package record, including cover page information and instruction sheets. It will only delete the most recent revision. To delete the most recent revision of a manufacturing package:

1. Select Delete on the Main Menu.
2. Enter the part number when prompted to do so.
3. The system will display the Purpose of Change Screen and prompt you with the message:
'Do you want to delete this? Y/N'

4. Enter 'Y' to delete the manufacturing package.
Enter 'N' to avoid deletion.
5. Once the package is deleted, the words 'Part number' will be displayed again to give you an opportunity to delete another record. If you have no more records to delete, press the PF4 key again to return to the Main Menu.

11.9 Using the Inquiry Option

The inquiry option will allow you to find out if the part is on file and, if so, which revisions are on file. The system will keep up to three revisions on file for each part. To use the inquiry option:

1. Select Inquiry on the Main Menu.
2. Enter the part number you wish to check and presss RETURN or ENTER.
3. If the part is not on file, the system will display a message stating that fact. If the part is on file, the system will display the revisions that are on file.
4. Use the PF4 key to return to the part number prompt. If you have no more records for inquiry, press the PF4 key again to return to the Main Menu.

11.10 To Exit the Manufacturing Package Information System

1. Use the PF4 key to return to the main menu.

2. Select the Exit option on the main menu and press RETURN or ENTER.
3. To exit the VAX system: Type 'LO' or 'LOGOFF'
NOTE: See Appendix A for log-off instructions if you are connected to the TRR Network.

12.0

AUTO COMPONENT INSERTER OPERATORS

This information is provided to familiarize a first-time user with the substance and operation of the VAX Auto-Insertion System. The system was created for the purpose of generating complete programs for Tracor's Universal insertion machines with the minimum of operator intervention.

In order to accomplish this, the VAX employs information provided by the operator, as well as raw data furnished by the ECAD (Electronic Computer-Aided Design) system, which provides the data for component coordinates, pin counts, and the keys with which other critical information may be obtained from the VAX Component and BOM (Bill of Material) data base.

With this information, and taking into account certain external conditions such as system configuration and part availability, the VAX attempts to generate the most efficient program possible in the time available. The resultant code is then loaded directly into the appropriate Universal machine for immediate use.

The VAX Auto-insertion program was designed and developed by the Tracor Systems Coordination department as an application within Tech Mod CAPS program.

12.1 System Anatomy

The Auto-Insertion System consists of four distinct components.

12.1.1 The Universal Insertion Equipment - The first component of the Auto-Insertion System is the insertion equipment itself. Currently there are two controllers and four different insertion machines.

CONTROLLER I - This is the first controller obtained by Tracor, and is considerably less advanced than the second one. Currently it controls two devices:

The Universal DIP - This machine was designed to insert dual inline package components. It is currently configured for the insertion of DIPs with 8, 14, 16, 18 and 20 pins. Provisions exist for the insertion of larger DIPs and DIP sockets, but they are currently not in use.

The Universal VCD - This machine is designed for the insertion of axial lead (variable center distance) type components, such as resistors, capacitors, and diodes.

12.1.2 CONTROLLER II - The second controller obtained by Tracor, it is more advanced than the first, especially in the software of its operating system. Currently, it controls two distinct devices that work together as one unit:

The Universal Sequencer Machine - The purpose of this device is to sequence the axial lead components inserted by the VCD machine onto a reel. The machine takes individual components from reels consisting of a single component type and orders them onto a master reel for the board to be inserted.

The Universal Component Verifier - This machine is attached to the Sequencer and is a direct extension of it. After a component has been deposited on the Sequencer conveyor chain, but before it is sealed onto the master reel, the Verifier can conduct simple tests relating to the components function. Capacitance, resistance, and tolerance are among the testable attributes. Currently this device is not operational and no automatic programming capability exists for it.

12.1.3 The Microcomputers - The third distinct component of the Auto Insertion system includes the TRS-80 microcomputers and their associated terminal software. Currently, there are two TRS-80's, one for each controller. Each TRS-80 runs a communications package written especially for the Auto-Insertion System. This package allows the transfer of files to and from the controllers, the TRS-80's, the VAX 11/750, and any peripheral printing devices.

12.1.4 The Host Computer System - The host computer system is a Digital Electronics Corporation (DEC) VAX 11/750 minicomputer. Currently configured with eight megabytes of onboard memory, two 456-megabyte hard disks, and a reel-to-reel tape back-up system, the VAX provides the computing power for the Auto-Insertion System. Using the VMS operating system, all VAX-based software was created using VAX Pascal.

12.2 The VAX/ECAD Database

Created and maintained as joint effort between Systems Coordination, ECAD and Manufacturing Engineering, the VAX database provides all of the information concerning the physical properties of the components and assemblies dealt with by the Auto-Insertion System.

12.3 Using the TRS-80 Terminal Program

Boot-Up the TRS-80

Turn the TRS-80 On - When the "Insert Diskette" message appears, place the program disk in the drive, with the label facing AWAY from the screen.

Note: If the TRS-80 in use is the one associated with CONTROLLER I, the operator must also switch the Giltronix port select to "AUTO" and turn power on. If the power is already on, then power the Giltronix off, and back on with a 2 second pause in between.

After the disk has been inserted and the door closed, CP/M will boot up automatically. When the A> prompt appears, enter the following from the keyboard:

For CONTROLLER I : "SATAI" {RETURN}

For CONTROLLER II: "SEQAI" {RETURN}

After several seconds, the main menu should appear on the screen, and the program is ready for use.

12.4 The Main Menu

There are two Main menus, depending upon which controller is in use:

CONTROLLER I

- (1) Upload a file
 - (2) Download a file
 - (3) Enter terminal mode
 - (4) Print a file
 - (5) Toggle modem link
- Your selection?

CONTROLLER II

- (1) Download a file
 - (2) Enter terminal mode
 - (3) Toggle modem link
- Your selection?

By pressing a numeric key, the corresponding menu item is initiated.

NOTE: When you are finished with this menu or any (sub) menu, pressing the {ESC} key will exit you back to the previous menu or back to the operating system.

From the menu above, each option is described below in the order in which they appear in the menu.

Menu Item: Upload a File - Uploading is the process of transferring information from a small machine to a larger machine.

The Upload reads a file (that was previously downloaded from somewhere) from the TRS-80 disk drive. Use of this option requires no operator intervention. Simply select the Upload option from the Main Menu, select the target device from the secondary menu that will appear and, wait for the menu to return.

A practical example of how one might use the Upload option: First, use the download option (which is described in the following section) to transfer an insertion program from the VAX to the TRS-80. For this example, let's say it's a Sequencer program for a Tracor assembly 141557_0002. Next, use the upload option to transfer this program to the Sequencer. NOTE: The download and upload are always used together to transfer files from one location to another.

Menu Item - Download a File - Downloading is the process of transferring information from a large machine to a smaller machine.

Upon selecting the download option on CONTROLLER I, a sub-menu is presented for the selection of the devices from

which the file is to be obtained. On CONTROLLER II, the VAX is the default source.

The Download option requires the operator to provide the name of the file to be downloaded. The operator will be expected to provide this information in response to the following prompt:

Enter file name:

When the operator wishes to download a program from the VAX, the file name will always have the format, "PA.R" where "A" is the Tracor assembly number for the board, and "R" is the revision level number/letter. "P" is a prefix that identifies which program is desired for this particular assembly. "DP" is the prefix that represents a DIP insertion program. "SP" represents a Sequencer program. "VP" represents a VCD insertion program.

For example, a file name in this format:

SP141557_0002.J

"SP" identifies that it's a Sequencer program. "141557_0002" is a Tracor assembly number. And, "J" is the revision level. In the case of uncertainty concerning the correct filename, the operator should consult the programmers of Systems Coordination or the Manufacturing Engineers who use CAPS.

Menu Item - Enter Terminal Mode - This option places the operator in terminal mode with the target device, which may be selected from the secondary menu that will appear. If the operator selects the VAX as the target, the VAX Auto-insertion program will automatically be activated. For all other devices, standard terminal communications will be established.

Menu Item - Print a File - Currently inoperative in this menu, but available through the VAX Auto-Insertion program, via "Print Reports" option in the main menu.

Menu Item - Toggle Modem Link - A feature that allows for communicating with the VAX via a modem. By selecting this option, the program will toggle back and forth from direct mode to modem mode. In the present installation, there is only a direct connect and no modem. The mode is displayed at the top of the screen as 'attach' or 'modem'.

12.5 Using the VAX Auto-Insertion Program

Logging on to the VAX - In order to use the VAX Auto-Insertion Program, the operators of the insertion equipment must log onto the VAX. This can be done through the terminal option on the TRS-80, or through a VAX terminal (preferably an ADM 22).

Login is automatic through the terminal option on the TRS-80, and the Auto-Insertion program is automatically initiated.

Login with the VAX terminal is a bit more involved. The operator must first find an unused VAX terminal. Turn the terminal on (wait for the screen to warm up) if it is not already. Press the {ENTER} or {RETURN} key several times. This action should get the VAX's attention and it will respond with a prompt:

Username:

Enter your Username followed by the {ENTER} or {RETURN} key. A Username should have been assigned to the operator by a programmer of Systems Coordination, usually the one with system management responsibilities.

If the Username was entered incorrectly then VAX will print a error message. If this is the case then press the {RETURN} key several times and repeat the procedure above.

If successful entry of the username then the VAX will prompt the operator for:

Password:

Now enter the password which was also assigned to the operator.

NOTE: since the password is to be kept secret, the letters, as they are typed, will not be echoed back to the screen. Press the {RETURN} key when done entering the password.

If the Password was entered incorrectly then repeat this whole procedure from the beginning.

If all has gone well, then the main menu of the Auto-insertion software should come up on the screen after a brief pause. This menu is discussed in the following sections.

12.6 The VAX Auto-Insertion Program

Upon entering the VAX Auto-Insertion program, either directly through a VAX terminal, or through the terminal option on the TRS-80 terminal program, a menu offering the following options will be displayed upon your screen:

- Enter program manager
- Edit fixture file
- Edit assembly file
- Edit system status
- Edit magazine lists
- Set pathmap parameters

Print reports

Return to VMS

The first option in the menu will be highlighted. By Pressing the "space bar" on the keyboard, the line, presently highlighted, will become unhighlighted and the next line will become highlighted. Pressing the "space bar" when the last line is highlighted will result the first line becoming highlighted. To select a option from this menu, press the {SPACE BAR} repeatedly until the option of choice is highlighted, then press the {RETURN} key.

Each of the options is described below, together with any sub-options associated to them, in the order they appear in this menu.

12.6.1 Enter Program Manager - Note: For new or revised assemblies, the "Edit" options should be completed prior to choosing the "Enter program manager" option.

This option allows the operator to cause the VAX to actually generate Universal insertion code. At this point, the operator will provide the VAX with the names of the Assembly. When this option is selected, a box-shaped border will appear on the screen with the following prompts inside it.

Fixture No. :

In response to the "Fixture No. :" prompt, the operator should enter the name given to the ASSEMBLY when it was created. In this case, "Fixture No." is a misnomer for "Assembly Name" which is arbitrary to what the operator defined it at set up. For this entry the suggested format should be used:

A.R

where "A" is the assembly number assigned to the assembly on the BOM, and "R" is current revision level.

NOTE: This is suggested format. An alternate format could be any text name, i.e., "trtt_eamux.J".

If, for any reason, the operator simply presses {RETURN} instead of entering data at the above option, this screen will abort and return the operator to the main menu.

After the operator has provided legal Fixture number, the VAX will proceed to generate the appropriate programs. The start of this process will be denoted by the clearing of the operators screen, and its completion by the reappearance of the main menu. When the main menu reappears, the operator may then load the completed programs into the associated machine through the use of the TRS-80 terminal programs, which are described in the previous section.

OPERATORS NOTE #1: During the generation of the Insertion Programs, the VAX will generate diagnostic information as to its progress. If an error is encountered for some unknown reason, a error message will be displayed and the screen will wait for a {RETURN} key to be pressed. At this time, the most advisable thing to do is contact the System Coordination Programmer, whoc is responsible for the Auto-Insertion software.

OPERATORS NOTE #2: Depending on what programs the operator elects to ahve generated, the VAX will provide one or more informational printouts at runtime. These printouts contain information vital to the operator, such as head and magazine assignments, component lists, and a list of those components which either the VAX or the operator has caused to be withheld from the program. Paper copies of these items can be requested to be printed on any VAX printer, via another Menu discussed later.

12.6.2 Edit Fixture File - This option allows the operator to define an insertion fixture to the VAX. When it is selected,

the following menu will appear on the screen.

- Edit a fixture
- Delete an old fixture
- List available fixtures
- Print list of fixtures
- Return to main menu

The selection of menu options for this menu is the same as the main menu. Each of the options is described below, together with any sub-options attached to them, in the order they appear in this menu.

Edit a Fixture - This option allows the operator to actually enter the information describing the fixture to the VAX. When this option is selected, a box labeled "Modify Fixture" will be drawn on the screen with the following prompt inside of it:

Name:

The operator's reply to this prompt may be any character string of no more than 15 characters in length, for instance "FRCT579V", which the operator might use to name a fixture to be used to insert a 579 numbered board for the FRCT line on the Universal VCD machine. If the operator simply hits {RETURN} instead of providing a name, the program will return to the Fixture menu.

Once the operator has provided the program with a legal fixture name, one of two things will happen, depending on whether or not the fixture already exists in the fixture file.

If the fixture already exists, then the program will proceed directly to the data entry phase.

Otherwise, if the fixture does not exist, then the message "This fixture is not currently on file. Do you wish to create it?" will appear below the prompt box. If the operator replies with an "N", for no, the program will return to the Fixture menu, otherwise a new fixture will be created using the name the operator provided in response to the "Name : " prompt, and the program will proceed directly to the data entry phase described below.

Data Entry Phase - Once the program has received a valid fixture name, and either found the existing fixture or created a new one, a form will be drawn on the screen requiring the operator to provide certain information concerning the fixture. In the case of an existing fixture, the operator may merely wish to modify some of the already existing information, but in any case the following information **MUST** be provided before the operator attempts to exit the data screen. The program will not permit the operator to exit the form until this has been done.

The operator may move freely about the data screen using the arrow keys, and full editing functions are available on those prompts that allow direct keyboard input.

Note: The Fixture name prompt shown on this screen is merely a reminder to the operator, and cannot be changed.

Orientation - Each window on a fixture must have a "reference pin" by which the VAX can identify it. The information entered at this prompt will tell the VAX which corner of the window this pin is located in. Only one reference pin is allowed, and it must be the same pin for all of the windows in a fixture. The options from which the operator may choose will appear in a menu at the lower right of the screen, and are limited to the following:

"Lower left"
"Lower right"
"Upper left"
"Upper right"

The operator should select the option that defines the location of the reference pin relative to the viewpoint of an operator facing towards the front of the machine in question. In the case of a fixture which has no corner pins, the operator should select "Lower left" and report the situation to the programmer, as special action will have to be taken.

The entry for this field is not typed in from the keyboard, as is usually the case, but is provided to the form from the menu that will appear in the lower right hand corner of the screen when the cursor reaches this option on the form. The MENU cursor may be moved in the four primary directions through the use of either the "J", "K", "L", "I" or "4", "5", "6", "8" keys, where

"J"/"4" is Left
"K"/"5" is Down
"L"/"6" is Right
"I"/"8" is Up

and may additionally be scrolled up and down through the use of
"-" for Up
"," for Down

In the event of a menu which contains more options than will fit in the space provided, the word "MORE" will appear at the bottom of the menu window.

As the cursor moves over the options in the menu, the text corresponding to that option will appear in the space next to the prompt with which the menu is associated. When the cursor is positioned on the desired option, simply press {RETURN}

and the option will be entered and the cursor will proceed to the next option in the direction it was last moving.

Window Count - This entry is simply an integer value stating how many windows this fixture has. The operator should provide the total number of windows on the fixture, regardless of whether the windows are actually usable. For example, if a fixture has six windows but two of them have broken claps, the operator will still replay six to this prompt.

Pin Coordinates - When the operator replies to the "Window Count" prompt FOR THE FIRST TIME the program will automatically draw a new, smaller form in the box on lower left of the screen. The prompt

Ref. pin X:

Ref. pin Y:

will appear in the box a number of times equal to the number entered at the "Window Count:" prompt. If the box is not large enough to contain all of the prompts, it will scroll when the cursor reaches the last visible prompt. When the operator has finished inputting coordinates, press {ESC} will return the cursor to the main form, at the location of the "Window Count:" prompt. At this point the operator may move to any desired prompt through the use of the arrow keys, including the "Pin Coordinates" form. Pressing {RETURN} while on the "Window Count:" prompt will allow the operator to exit the form.

Again, the "-" and "," keys may be used to scroll through the window, and full text editing is available.

Delete an Old Fixture - This option allows the operator to delete a fixture that is for some reason no longer needed. Up selecting this option, a box labeled "Delete Fixture" will be drawn on the screen, and the prompt

Name:

will appear inside of it. The operator may at this point either press {RETURN}, causing the program to abort back to the Fixture menu, or enter a fixture name. If the operator provides a name, one of two things will occur, depending on whether or not the fixture exists.

If the fixture does not exist, then the message "No such fixture on file." will appear beneath the box, and the cursor will return to the "name: " prompt.

If the fixture exists, then the question "Is this satisfactory?" will appear beneath the box, to which the operator may replay either "Y" or "N". If the operator replies "N" the program will return to the Fixture menu, otherwise the question "Are you sure?" will appear beneath the first question.

In order to delete the fixture, the operator MUST respond "YES" in either upper or lower case. Any other reply will cause the program to return to the Fixture menu without deleting the fixture.

List Available Fixtures - Selecting this option will cause the VAX to display all FIXTURES currently on file to the screen. If more fixtures are on file than will fit on the screen, the text "MORE" will appear on the bottom of the screen and pressing {RETURN} will allow the operator to view the next page. When all available Fixtures have been displayed, pressing {RETURN} will allow the operator to return to the fixture menu.

Print List of Fixtures - Selecting this option will cause the VAX to print a list of all fixtures currently on file on the current VAX system default printer.

Return to Main Menu - Returns the operator to the main menu.

Edit Assembly File - This option allows the operator to define an assembly to the VAX. When it is selected, the following menu will appear on the screen.

- Edit an assembly
- Delete an old assembly
- List available assemblies
- Print list of assemblies
- Return to main menu

The selection of menu options for this menu is the same as the main menu.

Each of the options is described below, together with any sub-options attached to them, in the order they appear in this menu.

12.6.3 Edit An Assembly - This option allows the operator to edit the information describing an assembly to the VAX. When this option is selected, a box labeled "Modify Assembly" will be drawn on the screen with the following prompt inside of it.

Name:

The operator's reply to this prompt may be any character string of no more than 15 characters in length, for instance "141578-0001.ND", which the operator might use to name an assembly for Tracor assembly number 141578-0001, Revision N, for use on the Universal D1P machine. If the operator simply hits {RETURN} instead of providing a name, the program will return to the Assembly menu.

Once the operator has provided the program with a legal assembly name, one of the two things will happen, depending on whether or not the assembly already exists in the assembly file.

If the assembly already exists, then the program will proceed directly to the data entry phase.

If the assembly does not exist as of yet, then the message "This assembly is not currently on file. Do you wish to create it?" will appear below the prompt box. If the operator replies with an "N", for no, the program will return to the Assembly menu, otherwise a new assembly will be created using the name the operator provided in response to the "NAME : " prompt, and the program will proceed directly to the data entry phase described below.

Data Entry Phase - Once the program has received a valid assembly name, and either found the existing assembly or created a new one, a form will be drawn on the screen requiring the operator to provide certain information concerning the assembly. In the case of an existing assembly, the operator may merely wish to modify some of the already existing information, but in any case the following information **MUST** be provided when the operator attempts to exit the data screen. The program will not permit the operator to exit the form until this has been done.

The operator may move freely about the data screen using the arrow keys, and full editing functions are available on those prompts that allow direct keyboard input.

NOTE: The "Assembly No. :" prompt shown on this screen is merely a reminder to the operator, and cannot be changed.

Fixture - At this prompt, the operator should provide the name he assigned to the **FIXTURE** on which the board in question will be mounted for insertion. The program will not accept a non-existent fixture, so the fixture named **MUST** have already been created. If the fixture name is approved by the

program, several things will happen.

The data in the "Fixture :" field will be locked, and the operator will not be able to change it without first exiting the form.

The "Reference Pin: " field will be filled and locked. This is only a reminder to the operator, and is not entered manually on this form.

A graphic representation of the fixture selected will appear in the window labeled "Fixture Template". This will be discussed in detail below.

DIP Rotation - The information to be entered here is an integer value between 0 and 3, inclusive which tells the VAX how many 90 degree increments the board will be rotated CLOCKWISE from the orientation in which it appears in the engineering drawing when it is mounted on the Universal DIP inserter.

VCD Rotation - The information to be entered here is an integer value between 0 and 3, inclusive which tells the VAX how many 90 degree increments the board will be rotated CLOCKWISE from the orientation in which it appears in the engineering drawing when it is mounted on the Universal VCD inserter.

Part Hold - Up replying to the "VCD rotation" prompt, a sub-form will appear in the lower left hand corner of the screen. The box in this location will fill with the following prompt:

Ref. designator or Part No. :

In response to these prompts, the operator may provide either a reference designator, or a Tracor part number from the BOM for the assembly in question. Only one reference designator or part number is allowed per prompt, and if more entries are needed than will fit in the sub-form, the sub-form will scroll when the last entry is reached. The operator may move between prompts at will through the use of the arrow keys, and may scroll rapidly through the use of the "-" and "," keys.

The information entered at this point represents those reference designators and/or part numbers that are listed on the BOM but the operator does not wish to include in the program. For example: the VAX data files indicate that reference designator R1 may be auto-inserted, but the operator is aware that this part hits tooling, and thus employs this function to instruct the VAX to withhold the particular reference designator. The parts and/or reference designators withheld may be of any component type. In any case, the manufacturing engineer is automatically notified when any parts are withheld.

When the operator has finished with this sub-form, pressing {ESC} will return the cursor to the main form.

DIP Code - This is a boolean field, to which the operator can only reply "Y" or "N". The operators response to this field instructs the VAX on whether or not it should generate a DIP program based on this assembly record.

VCD Code - This is a boolean field, to which the operator can only reply "Y" or "N". The operators response to this field instructs the VAX on whether or not it should generate a VCD program based on this assembly record.

Sequencer Code - This is a boolean field, to which the operator can only reply "Y" or "N". The operators response to this field instructs the VAX on whether or not it should

generate a Sequencer program based on this assembly record.

Verifier Code - This is a boolean field, to which the operator can only reply "Y" or "N". The operators response to this field instructs the VAX on whether or not it should generate a Component Verifier program currently not active) based on this assembly reocrd.

Defining the Fixture Template - At this point, the cursor will enter the box labeled "Fixture Template". The purpose of this area is to allow the operator to define exactly how the boards are to be treated by the VAX.

Each window on the fixture is represented on the screen by an inverse asterisk. The windows should be represented in the box in approximately the same way they appear on the fixture, bu the representation will not be exact. The operator may move his cursor from "window" to "window" through the use of the "8" (Left) and "9" (Right) keys.

Initially, each window is filled with an asterisk, which instructs the VAX to ignore that particular window. The operator may change the asterisk to any other printable character. When the VAX generates the programs, it will ignore any windows filled with asterisks, and it will group all windows flagged with the same symbol as one board. For example, the following arrangement of nine windows:

*	*	A
C	B	B
C	B	B

would cause windows one and two to be ignored, window three (A) to be inserted as one board, windows four and seven (C) to be inserted as another, and windows five, six, eight and nine (B) to be inserted as a third. Likewise, the six window arrangement of

A	A	A
L	L	L

would cause the fixture to be inserted as two distinct but identical windows, in which case the VAX would attempt to use two offsets, one for each "superboard".

When the operator has arranged the windows to the desired configuration, pressing {ESC} will return the cursor to the main form. At any point after this, pressing {RETURN} instead of an arrow key in response to the "Ver. code: " prompt will return the operator to the Assembly menu.

Delete an Old Assembly - This option allows the operator to delete a assembly that is for some reason no longer needed. Upon selecting this option, a box labeled "Delete Assembly" will be drawn on the screen, and the prompt:

Name:

will appear inside of it. The operator may at this point either press {RETURN}, causing the program to abort back to the Assembly menu, or enter an assembly name. If the operator provides a name, one of two things will occur, depending on whether or not the assembly exists.

If the assembly does not exist, th message "No such assembly on file." will appear beneath the box, and the cursor will return to the "Name: " prompt.

If the assembly does exist, the question "Is this satisfactory? " will appear beneath the box, to which the operator may replay either "Y" or "N". If the operator replies "N" the program will return to the Assembly menu, otherwise the question "Are you sure? " will appear beneath the first question. In order to delete the assembly, the operator MUST respond "YES"

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in either upper or lower case. Any other reply will cause the program to return to the Assembly menu without deleting the assembly.

List Available Assemblies - Selecting this option will cause the VAX to display all ASSEMBLIES currently on file to the screen. If more assemblies are on file than will fit on the screen, the text "MORE" will appear on the bottom of the screen and pressing {RETURN} will allow the operator to view the next page. When all available Assemblies have been displayed, pressing {RETURN} will allow the operator to return to the assembly menu.

Print List of Assemblies - Selecting this option will cause the VAX to print a list of all assemblies currently on file on the current VAX system default printer.

Return to Main Menu - Returns the operator to the main menu.

12.6.4 Edit System Status - This option allows the operator to define the condition of the Universal environment to the VAX.

When this option is selected, a three-area form is drawn on the screen. Each area is reserved for either Sequencer heads, DIP IC magazines, or Dip socket magazines. In the prompt reserved for each individual head or magazine, the operator may enter either "Y" or "N". "Y" means that head or magazine is operational and may be employed by the VAX, "N" no means that for some reason it is not. When the operator has properly configured the system, pressing {RETURN} while the cursor is positioned on the lowest, left-most prompt will cause the program to return to the main menu.

NOTE: The program always remembers the last configuration, and it is not necessary to use this option unless conditions have changed from the last time the program was run.

12.6.5 Edit Magazine Lists - This option allows the operator to assign specific parts to specific magazines or heads, thus simplifying the task of machine setup.

Selecting this option will cause the following menu to be displayed:

- Edit a part
- Delete an old part
- List available parts
- Print list of parts
- Return to main menu

The selection of menu options from this sub-menu is the same as the main menu. Each of the options is described below, together with any sub-options attached to them, in the order they appear in this menu.

Edit A Part - Selecting this option will cause a box labeled "Modify Part" to be drawn on the screen, inside of which the prompt

Part:

will appear. At this point, the operator should enter the part number that is to undergo assignment. One of two conditions will result, depending on whether the part number entered has already been assigned or not.

If the part has already been assigned, then the program will proceed directly to the data entry phase.

If the part has not been assigned yet, then the message "This part is not currently on file. Do you wish to

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create it?" will appear below the prompt box. If the operator replies with an "N", for no, the program will return to the main menu, otherwise a new assignment will be create using the part number the operator provided in reponse to the "Part : " prompt, and the program will proceed directly to the date entry phase described below.

The VAX will display a form on the scrren with only three prompts. Although the part number entered in response to the "Part: " prompt will be displayed at the top of the screen, it is only a reminder.

Free cursor movement is allowed through the use of the arrow keys.

The three prompts will be:

Primary :
Secondary:
Tertiary :

The response to each of these should be an integer value defining the magazine most favorable for this part, and two alternates in descending order of priority. The VAX will check to be sure that the magazine or head numbers are legal.

Upon pressing {RETURN} after the "Tertiary : " prompt, the program will respond with the query:

"Is this satisfactory? "

to which the operator may respond either "Y" or "N". "N" will cause the cursor to return to the "Primary : " prompt, while "Y" will cause the "Modify Part" box to appear again and return the cursor to the "Part: " prompt. If at any time the operator

presses {RETURN} instead of providing a part number in response to the "Part: " prompt, the program will return to the Edit magazine lists menu.

Delete an Old Part - This option allows the operator to delete a part that is for some reason no longer needed. Upon selecting this option, a box labeled "Delete Part" will be drawn on the screen, and the prompt

Part:

will appear inside of it. The operator may at this point either press {RETURN}, causing the program to abort back to the Edit magazine menu, or enter a new part number. If the operator provides a part, one of two things will occur, depending on whether or not the part already exists.

If the part does not exist, then the message "No such part of file." will appear beneath the box, and the cursor will return to the "Part: " prompt.

If the part exists, then the question "Is this satisfactory? " will appear beneath the box, to which the operator may reply either "Y" or "N". If the operator replies "N" the program will return to the Edit magazine menu, otherwise the question "Are you sure? " will appear beneath the first question. In order to delete the part, the operator MUST respond "YES" in either upper or lower case. Any other reply will cause the program to return to the Edit magazine menu without deleting the part.

List Available Parts - Selecting this option will cause the VAX to display all PARTS currently on file to the screen. If more parts are on file than will fit on the screen, the text "MORE" will appear on the bottom of the screen and pressing {RETURN} will allow the operator to view the next page.

When all available Parts have been displayed, pressing {RETURN} will allow the operator to return to the assembly menu.

Print List of Parts - Selecting this option will cause the VAX to print a list of all parts currently on file on the current VAX system default printer.

Return to Main Menu - Returns the operator to the main menu.

12.6.6 Set Pathmap Parameters - This option allows the operator to modify the operating parameters of the VAX Shortest Path Algorithm. Using this function, the extent to which the VAX will search for the shortest insertion path can be exactly controlled. Proper use of this option requires an understanding of the algorithms and data-structures involved, and it is intended for programmer use only.

Print Reports - This option allows the operator to print reports that are necessary for the operation and use of this software package. When it is selected, the following menu will appear on the screen.

- Print Exception List
- Print Dip Bin List
- Print Sequencer Big List
- Print Board Drawing
- Print Insertion Documentation
- Return to Main Menu

The selection of menu options for this menu is the same as the main menu. Each of the options is described below, together with any sub-options attached to them, in the order they appear in this menu.

Print Exception List - Prints the Exceptions List of parts that were withheld from insertion for one reason or other.

Print Dip Bin List - Prints a list of bins and their contents for the DIP inserter. Also a list of total number of parts to be inserted.

Print Sequencer Bin List - Same as the Dip Bin List, except for the difference in machines.

Print Board Drawing - Prints a graphical representation of the Board to be inserted. All components and mounting hole are labeled.

Print Insertion Documentation - Prints the documentation that you are reading now.

Return to Main Menu - Returns Operator to Main Menu.

Return to VMS - Returns the operator to system level or logs off the VAX.

13.0 ELECTRONIC CAD OPERATORS

This documentation is provided to familiarize a first-time user with the operation of the ECAD-LINK Workstation. This system was created for the purpose of transferring PWBA description data to the Manufacturing VAX 11/750 where the data is used to generate NC programs for the UNIVERSAL insertion equipment, to drive the computer aided repair workstation in Manufacturing Test, and to calculate component lead spacing information on the manufacturing instruction sheets.

13.1 Rear View of a KAYPRO 10

Refer to Figure 13-1. Important items, which are referenced in this text are labeled.

13.2 Turn the KAYPRO Terminal ON (If already on, then skip to Section 13.3)

The power switch is square and on the back of the KAYPRO. Press the top of the switch in. A light on the front of the computer should glow red. If the light does not come on, check to see if the computer is plug in. If it is, then check for a blown fuse. The computer will pause briefly to perform a self test. After warming up, a menu should appear on the screen. If nother is visible on the screen, check the brightness. This knob is on the back of the Kaypro.

13.3 MENUS

Each menu consists of a list of up to ten options, each labeled with a single numeric digit. Options are selected by simply pressing a '0' through '9' key. the KAYPRO will react accordingly. Not all options are accessable. Only options that display with bold/bright characters are user selectable. Others are for future expansion or remote functions. Every menu has an option to return to the previous menu.

Main Menu - The main menu consits of three selectable options:

File Capture - for capturing files from ECAL equipment.

File Utilities - for maintaining files on the KAYPRO.

System Services - for leaving the menu and going to CPM. This option should not be used except by Systems Coordination personnel.

File Capture Sub-Menu - This sub-menu is used to transfer a file from one of the ECAD systems to the KAYPRO 10. Upon selecting this option, the KAYPRO 10 will display a list of supported ECAD devices, and the user should select the desired system. Once an ECAD system has been selected, the user will be prompted for:

ECAD control number:

PWB number:

The user must enter this information, as it is used by the VAX and the Manufacturing Engineers to identify the circuit card assembly in question.

After this information has been entered, instructions for completing the file transfer will be listed on the screen. These instructions are self explanatory, but will differ depending on which ECAD system is being accessed.

An example of the instructions given for capturing a file from the REDAC-1 machine:

Capture file from REDAC-1

Instructions:

- (1) Run REDCON to transfer the file to
DKO:TRANSF.ER
i.e., R REDCON
DKO:TRANSF.ER<DK1:B3FILEINI
- (2) Flip Switch on the switch box to .
- (3) Press the {RETURN} key.
- ()

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This System is made feasible by certain equipment: a VAX 11/750, KAYPRO 10, Electronic/Manual Switch Boxes, and the ECAD systems.

The Electronic Computer-Aided Design (ECAD) systems are used to design the electronic assemblies that go into many of Tracor products. From this, we build our VAX resident databases of how the boards are laid out.

The switch boxes allow the reconfiguration of cable connections, between computers and peripherals in the ECAD room. This allows the KAYPRO 10 to be connected to 7 devices.

The KAYPRO 10 is a microcomputer with a 10-megabyte hard disk. It functions as a remote data collection device for the VAX.

The VAX 11/750 is a repository for the ECAD and BCM databases which are used in other VAX based applications.

The KAYPRO 10 connects to the ECAD equipment (via the switch boxes) at baud rates as high as 19.2K. Data can therefore be rapidly be transferred to the KAYPRO 10, resulting in minimal transfer time for the ECAD operators.

The VAX will connect to the KAYPRO 10 by 1200 baud modem during non-peak hours and access the data in the KAYPRO 10. Since this is done over phone lines, there are security features that resist unauthorized access.

The ECAD-Link was designed and developed by the Manufacturing Division's Systems Coordination department as an application within Tech Mod CAPS Program.

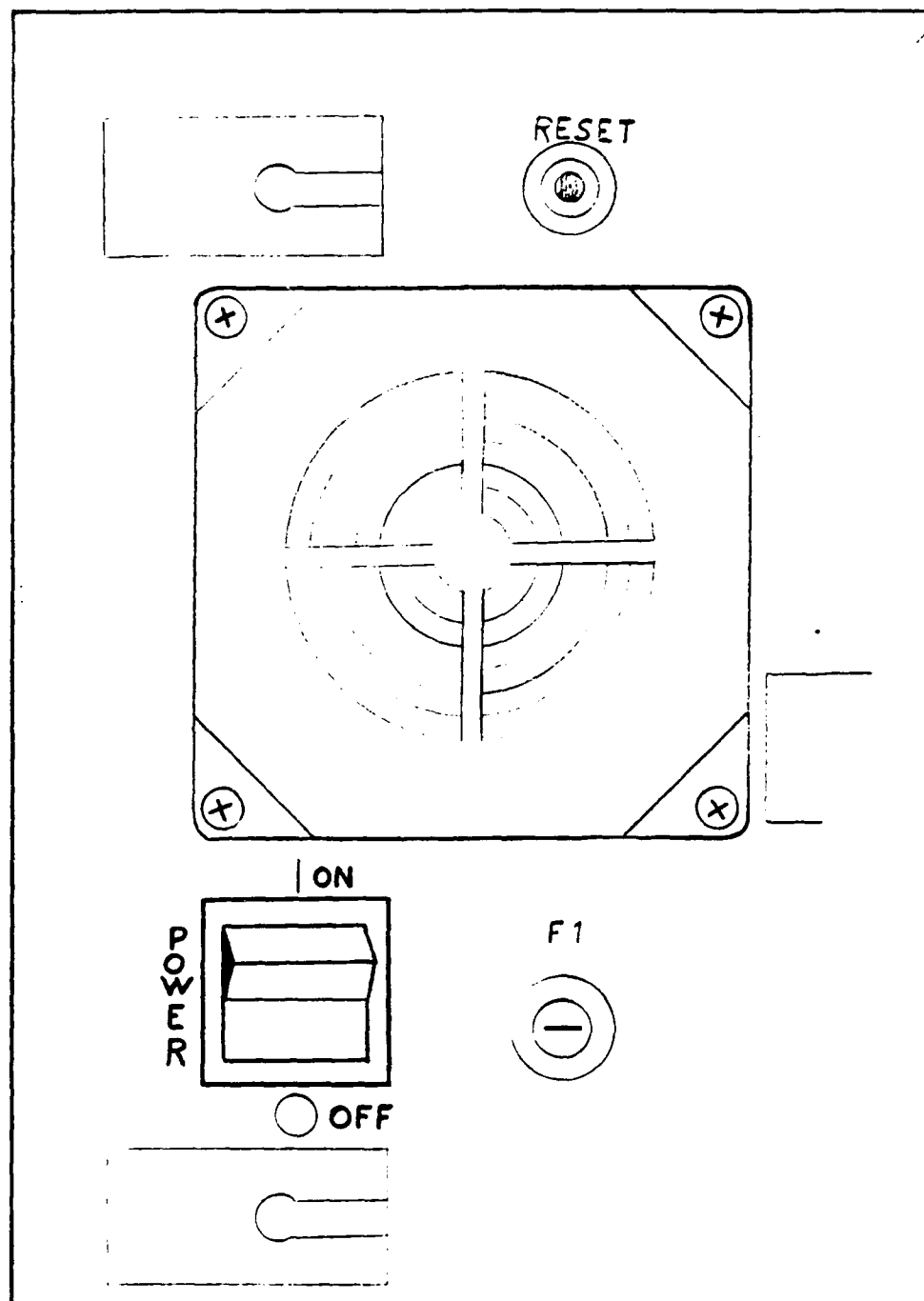


Figure 13-1
Rear View of a KAYPRO 10

After pressing <RETURN>, the Kaypro will proceed to communicate with the REDAC. Upon the completion of the file transfer, the following screen will appear:

Capture file from REDAC-1

Instructions:

- (1) Flip Switch on the switch box to <A>.
- (2) Press the <RETURN> key.
- (_)

Pressing the <RETURN> will bring the main menu back up on the screen.

File Utility Sub-Menu - This menu is devoted to little utility programs that are used to maintain files. Typically, the user should have no need to access this option, except to send mail to a Manufacturing Engineer.

DISKSPACE LEFT - exactly that.

FILE LIST - a directory listing of the disk.

WORD PROCESSOR - access to the WORDSTAR editor.

VAX MAIL - allows the direct access to the VAX
and its mail utility

WORDSTAR is documented in the KAYPRO WORDSTAR manual.

VAX MAIL is documented in the VAX user guide.

14.0

COMPUTER AIDED REPAIR OPERATORS

This information is provided to familiarize a first-time user with the operation of the Computer Aided Repair (CAR) Workstation. This system was created for the purpose of assisting a repair technician in rapidly locating failures on Printed Wiring Board (PWB) Assembly and suggesting the replacement parts by the Tracor part number that was used in

construction.

This System could not be possible without a number of major components: a VAX 11/750, the Seiko graphics terminal, the UNIVAC mainframe, HP3065 and ECAD Systems.

The Electronic Computer-Aided Design (ECAD) systems located in Building 6 are used to design the electronic assemblies that go into many of Tracor products. From this, we build our database of how the boards are layed out.

The HP3065 performs tests on a number of boards that are produced within Tracor. From this machine, we collect diagnostic data of detected failures.

From the UNIVAC mainframe, a database of which parts go into the construction of various assemblies. This database is referred to as the Bill of Material (BOM).

A Seiko graphics terminal is a high resolution graphics display that allows an image to be drawn and labeled in eight different colors.

A VAX 11/750 is used to connect the three previously mentioned components of this system. It is also a epository for the ECAD and BOM databases which are used in other VAX based applications.

The CAR workstation was designed and developed by the Tracor Systems Coordinations department as an application within Tech Mod CAPS Program.

14.1 Turn the Seiko Terminal On (If already on, then skip to Section 14.2.

The power switch is a rectangular button, located at the front lower right-hand corner of the terminal. Press the switch in. The terminal will pause briefly to perform a self test. After warming up, a message should appear on the screen.

If nothing is visible on the screen, check the brightness.

The brightness control is in the upper right-hand corner and is labeled. If the brightness knob is not protruding, then press in and release. It will pop out for easy grasp. Now adjust the brightness with the knob in both directions.

"READY" should appear in the middle of the screen.

If anything else appears on the screen, a hardware malfunction occurred. Contact the programmers.

14.2 Login to the VAX

Press the "ENTER" or "RETURN" key several times. This action should get the VAX's attention and it will respond with a prompt:

Username:

Enter "CAPSCAR" for the username, and press the "RETURN" key.

The VAX will respond with another prompt:

Password:

Now enter the password of "CAPSCAR", and press "RETURN".

Since passwords are ideally kept secret, the letter, as the password is being typed, will not be echoed back to the screen.

If the username or password is mistyped, then the VAX will print an error message. If this is the case, then restart at Section 14.2.

If all has gone well, a menu of available boards will be displayed. This screen will be discussed in the next section.

14.3 Select an Assembly

A directory listing of all of the assemblies will appear on the screen. Wait till the next prompt appears:

BOARD ASSEMBLY NUMBER:

In response to this prompt, the operator has two options.

Enter "DONE" to exit and log off the system.

Or enter one of the assemblies listed in the directory listing. This assembly number is in the format of "A.R", where "A" is the assembly number assigned to the assembly on the BOM and "R" is its current revision level. Press "RETURN" to complete the entry of this number

At this point, the VAX will search the databases. A number of error messages are possible; this all depends on if the number was properly entered or if the BOM is available.

14.4

Computer Aided Repair - Display Explanation

PWBs are illustrated as a top view with a green boarder. Components are drawn in dark blue and pads/pins are in light blue. Pins have two shapes, diamond and square. The square pads represent "pin one" of a component. The assembly number is in white along the right side of the screen. Across the top of the screen, are four date-entry fields. Each one is of a different color, from left to right: White, Yellow, Purple, and Red.

These are the colors of highlighting. By entering a Component's referene designator in the White field, the component in question will be redrawn on the board in that color. With four colors, four different components can be distinguished simultaneously.

14.4.1

Highlighting a Component

By entering a part's reference designator, it will be highlighted.

For example, "C12" is reference designator for Capacitor twelve. Entering "C12" followed with the "return" key, will cause capacitor 12 to be highlighted. Also, the Tracor part number used in construction of this assembly will be displayed on the second line of the screen along with a short description of this part.

Also, if the assembly was tested on the HP3065 and the serial number was entered (to be discussed later), the reason the part failed will be displayed at the bottom of the screen. This failure message consists of 4 parts: type of tst (resistance, capacitance..), measured value, out of tolerance in what direction (high, low...), and limits.

Component highlighting is a very fast way to locate components that have been diagnosed as defective, and eliminates the need for using the paper tape output of the HP3065.

14.4.2 Highlighting a Trace Segment

By entering a pin number followed by a reference designator, the CAR workstation will highlight the traces connected to that pin of that part. Depending on the entry field, the traces will only be on the top of the board or on the bottom of the board. The operator will notice next to each entry field that there appears a "top" or "bottom". This is only relevant to highlighting trace segments.

For example, "Q3" is the reference designator for Transistor three. Let's say we want to find out what is connected to the emitter of this transistor. The emitter is pin one on the transistor. This pin would be illustrated with a square pad on the CAR workstation. Enter, "1Q3" and press the "return" key. Let's also say this was done in the purple entry field. The result: all the traces and pads on the top side of the board which connect electrically to pin one of "Q3" will be highlighted in purple. Also, the cursor will move to the entry field to the right, the red field. If we wish to see the bottom traces, enter "1Q3" in the next field.

Trace highlighting is very useful when a board has been diagnosed as having an electrical short. Highlight the two traces that are shorted together. Look for where the traces and their pads come close together. Examine the board in these areas.

14.4.3 Clear Highlighting

To remove highlighted components or traces, enter

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"CLEAR" followed by a return or press the 'clear key'.

14.4.4 Component Labeling

To label all the components and mounting holes, enter "LABEL" followed by a return or press the 'label key'. This has uses in finding out the reference designators of everything connected to a trace segment.

14.4.5 Redraw the Board

To completely redraw the board, enter "REDRAW" followed by a return or press the 'redraw key'.

14.4.6 Auto Tested Boards

If a board was tested on the HP3065, then it is possible to bring up a list of failed components. Enter "SERIAL" followed by a return or press the 'serial key'. There will be a prompt at the bottom of the screen for the serial number of the board. Enter the serial number followed by a return. Then it will check its database for this board. If it does not find the board then it will display an error message at the bottom of the screen. Otherwise, a list of defects will be listed to the left of the screen.

14.4.7

Quit

To exit this program once finished using, enter "QUIT" followed by a return.

14.4.8 List of Commands

component highlight, i.e. 'C15'

trace highlight, i.e. '2C15'

CLEAR - clear the board of all highlighted parts.

REDRAW - redraw the board.

LABEL - label all the components.

SERIAL - allows the entry of a serial number and gives failure information, accumulated from the HP3065.

QUIT - leave the CAR workstation.

14.5

Component's Pin Convention

Diode Pin 1 = Cathode.

 Pin 2 = Anode.

Polarized Capacitor Pin 1 = Positive.

 Pin 2 = Negative.

Transistor Pin 1 = Emitter;

 Pin 2 = Base, clockwise of pin 1.

 Pin 3 = Collector clockwise of pin 2.

I.C. Pin 1 = Pin 1.

 Pin 1 = counterclockwise of pin 1.

VOLUME II

ATTACHMENTS

APPENDIX A
FAB LOG-ON AND LOG-OFF INSTRUCTIONS
FOR TERMINALS CONNECTED TO THE TRR NETWORK

IMPORTANT: You must use capital letters when typing log-on & log-off instructions.

LOG-ON INSTRUCTIONS

1. Press BREAK twice and wait about 5 seconds.
2. Then press RETURN 2-3 times.
3. The system will show a message similar to the following:

```
Welcome to the TRR network
Wed Jan 21 08:57:05 1987
Port ID: AUSTIN 90-12 at 9600 baud
>
>
>
```

4. Type 'SPOCK' at the prompt and press return.
5. The system will respond with the following:

SPOCK password:

6. Type 'SAAVIK' after the message and press return.
7. The system will respond with a message similar to the following:

Reconnecting AUSTIN 90-12 to SPOCK TIG7

Username:

8. Type your Username and press return.
9. The system will respond with the following:

Password:

10. Type your Password and press return.
11. If your system is not set up to start FAB automatically, type 'FAB' at the '3' prompt.

LOG-OFF INSTRUCTIONS

1. Exit the FAB program as described in section 9.0 of the FAB manual.
2. Press BREAK twice and wait about 5 seconds.
3. Then press RETURN 2-3 times.
4. The system will show a message similar to the following:

```
Welcome to the TRR network
Wed Jan 21 08:57:05 1987
Port ID: AUSTIN 90-12 at 9600 baud
>
>
>
```

4. Type 'DISC' at the prompt and press return.

ATTACHMENT B
WORK CENTER KEY WORDS

The following key words will cause the associated work center number to be printed automatically on the cover sheet. This makes it unnecessary to enter the work center number on the instruction sheet screen. Enter the word(s) in the 'KEY' column below in the Instruction field on the instruction sheet screen and the Work Center Number and Description will automatically be printed on the cover sheet.

<u>KEY</u>	<u>WORK CENTER</u>	<u>DESCRIPTION</u>
MILL TURN	451215	MILL TURN
TIG WELD	391200	TIG WELD
BRAZE	391300	BRAZE
HEAT TREAT	391400	HEAT TREAT
MOLD	391500	MOLD
IDENTIFY MS	391500	IDENTIFY
GRIND WS	391600	GRIND
DEGATE	391510	DEGATE
ANNEAL	391510	ANNEAL
RECEIVE	481100	RECEIVE
ISSUE	481100	ISSUE
MATERIAL PREP	481100	MAT'L PREP
SHEAR	481100	SHEAR
SAW	481100	SAW
CUT	481100	CUT
VERIFY SM	481100	VERIFY
STRAIGHTEN	481000	STRAIGHTEN
APPLY SM	481000	APPLY
WRAP SM	481000	WRAP
TOUCH UP SM	481000	TOUCH UP
SEPARATE	481000	SEPARATE
REMOVE	481000	REMOVE
TURN	451220	TURN
LATHE	451220	LATHE
DEBURR SM	481200	DEBURR
GRIND SM	481200	GRIND
NC PUNCH	481310	NC PUNCH
PUNCH	481320	PUNCH
BLISS	481330	PUNCH
FORM	481400	FORM
FLATTEN	481400	FLATTEN
ROLL	481400	ROLL
BLEND	481500	BLEND
RADIUS	481500	RADIUS
MATCH DRILL	481500	DRILL
GLUE	481500	GLUE
FILE	481500	FILE
NOTCH	481500	NOTCH

ATTACHMENT C - COVER SHEET

PART NUMBER 134008-SA02	DESCRIPTION PLATE, BREECH	PAGE OF 1	PROGRAM MASTER DISP.
----------------------------	------------------------------	--------------	-------------------------

MP REV	PURPOSE OF CHANGE	MFG ENG DATE	QUAL ENG DATE	OPER	WORK CENTER	DESCRIPTION	SETUP	RUN
—	CREATE -SA02 TO PERFORM SUBSSY. OF 134008-0002.	GCK 09/18/86	/ /	0010	471300	SILKSCREEN	0.10	0.036
A-	VAX Format/Add ECO T30761-00 to dwg 134007	11/19/86	/ /	0020	471600	INSTALL	0.10	0.036
			/ /	0030	471010	MASK	0.10	0.033
			/ /	0040	471200	PRIME	0.20	0.004
			/ /	0050	471200	PAINT	0.20	0.008
			/ /	0060	471010	UNMASK	0.10	0.013
			/ /	0070	471000	WRAP	0.20	0.019
			/ /	0075	711100	INSPECT	0.00	0.000
			/ /	0079	360000	TOLLGATE-2	0.00	0.000
			/ /	0080	360000	STOCK	0.00	0.000

MANUFACTURING PACKAGE				SPECIAL NOTES	
FSCM	PRE	DOCUMENT	TYP	RV	TOLLGATES
19397		134008	DWG	N	2
19397	PL	134008-0002	PL	D	2
	BOM	134008-SA02	BOM	-	2
19397		134007	DWG	J	2
		T30761-00	ECO		
19397		134035	DWG	C	2
<input checked="" type="checkbox"/> UPDATE EXISTING <input type="checkbox"/> MANUFACTURING PACKAGE <input type="checkbox"/> ALLOW ALTERNATE <input type="checkbox"/> BUILD CONFIGURATIONS NOTE: PLATES SHOULD BE PROTECTED THROUGH- OUT ALL PHASES OF FABRICATION.					

ATTACHMENT D - INSTRUCTION SHEET

PART	DESCRIPTION	PAGE	REVISION
134008-SAO2	PLATE, BREECH	2	A-
SET -UP RUN			
0010	NOTE: BREECH PLATES ARE TO BE HANDLED WITH CARE; WRAPPED IN BUBBLE, OR SOME OTHER TYPE OF PROTECTIVE WRAP. THIS WRAP IS TO FOLLOW PLATE THROUGHOUT ALL PHASES. PLATES SHOULD NEVER MAKE CONTACT WITH ANOTHER PLATE, OR HARD SURFACE.		
0020	Silkscreen and identify per Notes #2 and #14 of dwg. and SP 141.		
0030	Install cover (BOM item 1001) with screws (BOM item 1002) to breech plate (BOM item 1003) per dwg. no. 134007		
0040	Mask per dwg. note #8.		
0050	Prime per dwg. 134008 note #7 and dwg. 134035 notes #5 & 6. Ref. to SP 148.		
0060	Paint per dwg. 134008 note #7 and dwg. 134035 notes #5 & 6. Ref. to SP 148.		
0070	Unmask part.		
0080	Protective wrap (Bubble wrap).		
0090	Inspect part, installation and paint per applicable dwgs. and BOM. Ref. IPG 1003, IPG 1002, SP 141 and SP 148.		
0100	Tollgate-2.		
0110	Route to Stock		

APPENDIX II

PROGRAM DOCUMENTATION

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1.0

PROGRAM DOCUMENTATION

This information is intended for programmers, not users. It assumes that the reader has a fair understanding of what CAPS does (i.e., the meaning and function of an Input Sheet, BOM, etc.)

There are several related yet unique functions within the CAPS system, which will be discussed individually. There are:

Prepare/edit/print a manufacturing package
Generate auto insertion programming
Display a printed wiring board using the Computer Aided Repair station

The CAPS software and data are stored in a single top level directory tree called {CAPS}. The Physical device should be specified using the label SYS\$CAPSVOL:. This label should be equated to the appropriate physical device. Example: \$ Define/system sys\$capsvol: DUAO:

The following logical names are defined within CAPS to represent sub-directories:

CAPSPROGS	[CAPS.PROGS]	Executables, .exe & .com files
CAPSDAT	[CAPS.DAT]	Misc. data files
CAPSError	[CAPS.ERR]	Error logs
CAPSBOM	[CAPS.BOM]	Bill of Materials
CAPSIS	[CAPS.IS]	Input sheets
CAPSTIS	[CAPS.TIS]	Prepared instruction sheets
CAPSCOVER	[CAPS.COVER]	Cover sheets
CAPSTCOVER	[CAPS.TCOVER]	Printable cover sheet
CAPSCAD	[CAPS.CAD]	CAD cross reference files

The following sub-directories exist without logical names:

[CAPS.SRC] .PAS and .QP source files

To run the CAPS Manufacturing Package system, run [CAPS.PROGS]MENU.COM. This program will set the above logical names and the following global symbols:

```
PRINT      ==  "PRINT/FORM=TRACORSTD"
IS          ==  $CAPSPROGS:IS
PRLIST     ==  $CAPSPROGS:LIST
SHEETPRINT ==  $CAPSPROGS:ISPRINT
GETDIR     ==  $CAPSPROGS:SHOWDIR
```

MENU.COM will then run CAPSMENU.EXE which will handle most of the menu functions. CAPSMENU.EXE will SPAWN other programs via the above defined verbs or directly, as required by the selected menu option.

2.0 CAPS DATA FILE NAMING CONVENTIONS

Tracor part numbers are 15 digit alphanumeric identifiers, which may also include several special characters. Revision identifiers are similar, but only 4 characters in length. Separate files are created for each part number, with the file name itself created from the part number, and the file extension from the revision. The DASH character "-" is replaced with underscore. Any other special character which is invalid as a filename character is coded by a "\$" followed by the hexadecimal value of the character. For example:

Part Number	Revision	Filename
123456-0001(S)	AB-1	123456_0001\$26S\$27.AB_1

The different types of data files are kept separate from each other by placing them in different directories. This applies to Input Sheets, Cover Sheets, BOM's, Prepared Instruction Sheets, Printable Cover Sheets, and CAD Cross Reference files. Since

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revision levels do not apply to Cover Sheets (and printable cover sheets), the file extension is fixed as .COV (and .GFX).

File Type	Logical Path	Physical Path
Input Sheet	CAP SIS	[CAPS.IS]
Cover Sheet	CAPSCOVER	[CAPS.COVER]
BOMs	CAPSBOM	[CAPS.BOM]
Instruction Sheets	CAPSTIS	[CAPS.TIS]
Printable Cover Sheets	CAPSTCOVER	[CAPS.TCOVER]
CAD Cross References	CAPSCAD	[CAPS.CAD]

The following executable and command files are used in the Manufacturing Package module. They perform as described.

MENU.COM	Initializes the labels, etc. Then runs CAPSMENU.EXE
CAPSMENU.EXE	The CAPS menu driver. Runs the following programs are required
AUTODOWN.EXE	This program controls the BOM download sequence. It calls the EDT editor, through which the user enters part numbers. It then prepares some files and submits UNIVAC.COM as a batch job.
UNIVAC.COM	This command file actually downloads the requested BOMs.
AUTOFORM.EXE	Run by UNIVAC.COM to translate the downloaded BOMs into a CAPS usable format (to BOM file in CPASBOM). Also creates cross reference for CAD data.
WRITEFILE.COM	Write error log file if needed
IS.EXE	This program performs the edit/modify functions to the input sheets stored in CAPSIS. A BOM must be available. SPAWNED by CAPSMENU
ISPRINT.EXE	This program creates a text file from the input sheet and SPAWNS a print of it. SPAWNED by CAPSMENU

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COVER.EXE	This program performs the edit/modify functions to the cover sheets stored in CAPSCOVER. SPRAWNED by CAPSMENU
PREP_IS.COM	This command procedure runs in batch, submitted by CAPSMENU. All it does is run LIST.EXT
IS_TO_PREP.DAT	Simple data file created in CAPSMENU. Used by LIST to know details about what to do
LIST.EXE	This program creates a prepared instruction sheet from an input sheet, and a printable cover sheet from a non-printable cover sheet. It is called by PREP_IS.COM. It get parameters from IS_TO_PREP.DAT, which is created by CAPSMENU.
CAPSEDT.EDT	Edit parameter file, used when EDT invoked to view prepared instruction sheet.
COMPONENT.EXE	Called by CAPSMENU, this program allows user to view/edit/print records in the component parameter file.
FILE.EXE	Called by CAPSMENU, this program allows user to view/edit/print records in the method code file.
MCA_COMMAND.COM	This command file is submitted as a batch job by CAPSMENU, it runs the method code analysis routine in background.
MCA.EXE	This program actually does the method code analysis. It is run by MCA_COMMAND.COM
SHOWDIR.EXE	This program shows on the screen which files are available and allows the user to page forward, backwards, etc. Active for input sheets, instruction sheets, cover sheets, printable cover sheets, CAD cross references, and BOMs.
STATUS.EXE	Allows viewing and editing of the master assembly status file. Presently users have no access to this program.

3.0

OVERVIEW OF CAPS DATA FILES

ASSEMBLY_STATUS.DAT Contains the file status of each assembly in CAPS.

BOMLIST.DAT List used by DOWNLOAD program to pull BOM data from Univac Computer. Consists of assembly number followed by related CAPS BOM filename.

COMPONENT.DAT Electrical parameter database of components. Used for auto-insertion programming.

DIALOG.DAT Data file used by DOWNLOAD program to control automatic logon and CAPS BOM download from Univac.

METHODCD.DAT Associates method code with a descriptive text and standard time. Used in instruction sheet generation and output.

UBOMLIST.DAT File containing a list of assembly numbers whose BOMs should be taken from the Univac. Input by users through the AUTODOWN program, this data is also mailed by UNIVAC.COM as a record of the transaction when the download ends.

UNIBAD1.TXT Standard text mailed by UNIVAC.COM if an error occurs during the BOM download/reformatting process.

UNIGOOD.TXT Standard text mailed by UNIVAC.COM if the BOM download/reformatting process completes without error.

CAPSEDT.EDT Initializes EDT for the non-destructive viewing of prepared instruction sheets in 132 columns. Used in CAPSMENU program.

4.0

THE METHODCODE FILE

The methodcode file associates a three letter code with a standard instruction text and a standard work time. The fields in the file record contain the (3 letter) code, several instruction lines, a line for internal reference, and the standard time in hours.

The RUN field is a 1 character field showing whether the time is used for set-up or run. It should either hold an "R" or an "S", if it is blank or contains an unacceptable value. consider it to be an "R", a run time value.

The VCODE field is a map of the way to interpret the 2 variable fields present on the input sheet. Acceptable values are:

- "T" Test. The field contents are inserted in the method code instruction text at the point marked by the "=" char.
- "C" Calculation. Some calculation needs to be performed, possibly using the value in the variable field as input. Details on the exact formula come from the Manufacturing Engineer. Formulas are hard coded into the CAPS software.
- "L" Lead spacing. This item number has a lead spacing value which should be taken from the CAD file.

Note that on the input sheet there are two variable fields. The interpretation of these depends on the position and value of the characters in the VCODE field. For example, if the VCODE field contains "TC", the first variable is taken to be a text field, and the second shows that a calculation must be performed.

5.0 MASTER ASSEMBLY FILE

This file shows the status of all assemblies in CAPS. It lists up to two revision levels for each assembly (the maximum number accessible for CAPS), and has flags to show whether the external BOM and CAD files have been downloaded and reformatted, and the status of the instruction input sheet. All of the CAPS instruction sheet software is driven off of this file; the assembly and the correct revision number must be present in the file, and the BOM-pulled flag must be set before

the IS.EXE program will attempt to read the input sheet file. The BOM-xref and CAD-xref flags must be set before IS.EXE will try to transfer the CAD lead-spacing data to the input sheet.

6.0 DOWNLOADING BOMs

The text files of BOMs which are successfully downloaded and reformatted are deleted automatically. If either the download or reformatting fail, the file is NOT deleted, but remains in the [CAPS.DAT] directory. The information required is obvious by examining the BOM record format.

7.0 CAD INTERFACE

After the BOM file is reformatted, a cross-reference file with the same name is created in the [CAPS.XREF] directory. This file is keyed by the reference designator of each component in the BOM file, and each record is loaded with the item number of that component. At this time, the MASTER_ASSEMBLY.DAT will be updated, the assembly and revision number will be added if not present. The BOM_PULLED flag will be set true when the BOM reformat program completes successfully, and the BOM_XREF_CREATED will be set true when the cross-reference file is created and loaded.

When the CAD data is downloaded, several things should happen;

1. The CAD_PULLED flag in the MASTER_ASSEMBLY.DAT file should be set true whenever a file is downloaded.
2. The X-Y coordinates and the lead spacing for each component should be written to the cross-reference file in [CAPS.XREF].
3. The CAD_XREF flag in MASTER_ASSEMBLY.DAT should be set true when this is done.

If these flags are not set, the IS.EXE program will not automatically insert the lead-spacing data in the input sheet.

8.0 PERIODIC HOUSECLEANING

For the most part, CAPS cleans up after itself very well.

[CAPS.DAT] may build up unnecessary files from failed downloads and batch log files.

CAPS only maintains 2 revision numbers of any given assembly, and the valid revisions are kept in the ASSEMBLY_STATUS.DAT file. Only assemblies listed in that file are accessible through the instruction sheet software, so any sets of files for other assemblies not present in ASSEMBLY_STATUS.DAT should be deleted. These are found in [CAPS.BOM], [CAPS.IS], [CAPS.CAD] Directories.

[CAPS.TIS] holds prepared instruction sheets. These files expire and are deleted seven days after they are created. This is because they are large text files, and take up alot of space. They can always be recreated, if need be.

9.0 ERROR HANDLERS

Examples of error handling routines are found in AUTOFORM.PAS and AUTOUD.PAS. AUTOUD isn't used anymore, but is has an example of trapping a fatal error and converting the status to information to prevent a program crash. The appreach might be useful someday. It worked, at least, before it became unnecessary.

10.0 KNOWN RESTRICTIONS

There are a few boards with so many components per part number that the list of reference designators will not fit

in the present BOM file format (arbitrarily limited to 255 characters, or a minimum of 63 reference designators depending on format).

11.0

SPECIAL CONSIDERATIONS

The Instruction Sheet preparation requests are queued up in a special queue, CAPS\$BATCH system batch queue. This queue has a priority of 4 but an execution limit of 1. When we allowed more jobs to be executed simultaneously, CAPS would bog down the rest of the system (10 prepares running at once.) But when we set their priority down, it took them too long to complete. So now they get them quickly, but one at a time.